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PREDATION BY SHORT-EARED OWLS ON A SALICORNIA SALT MARSH

BY RICHARD F. JOHNSTON

THE Short-eared Owl (*Asio flammeus*) is a regular and common winter visitant to the San Francisco Bay region of California. It lives there in suitable habitat from August and September until about the first week in May. The winter populations of this owl leave in late April for northern or interior breeding grounds. Short-eared Owls may breed in the marshes around San Francisco Bay and elsewhere in the region (Grinnell and Wythe, 1927:85); however, none has been recorded doing so in recent years. All owls dealt with in this paper have been migrants or winter residents.

The study area was a part of San Pablo salt marsh, one mile north-northwest of Richmond, Contra Costa County, California. This marsh is a good example of a San Francisco Bay salt marsh (see Hinde, 1954); it is characterized by two plant associations. There is on low ground, subject to daily tidal coverage, the *Spartina* zone, characterized by extensive pure stands of *Spartina foliosa*. Short-eared Owls are uncommon in the *Spartina*. Higher ground is covered by the *Salicornia* association (Fig. 1). The dominant plants of this zone are *Salicornia ambigua*, *Grindelia cuneifolia*, and *Distichlis spicata*. *Grindelia* is a woody perennial growing along the tidal creeks, or sloughs, on the more elevated parts of the marsh. All the dominants of this zone may be found in the lower zone wherever the elevated slough banks produce higher marsh conditions. Other important plants of this association are *Frankenia grandifolia*, *Jaumea carnosa*, *Limonium commune*, *Triglochin maritima*, *Cuscuta salina*, and *Achillea millefolium*. It is in this area of the marsh that Short-eared Owls find conditions most suitable for foraging and concealment.

On the upper portion of the marsh where the tidal sloughs branch in intricate patterns the densest and tallest vegetation on San Pablo marsh is found. This is composed mainly of leafed-out *Grindelia*, but there is a varying admixture of *Distichlis* and *Salicornia*; the height reached is two to four feet. Short-eared Owls find roosting cover in daylight hours in these tangles, especially when there is stranded driftwood amongst the plants. Less frequently the owls are found in small, irregularly-shaped openings in the *Salicornia* mat or within clumps of arrowgrass (*Triglochin maritima*). Individuals of this plant commonly grow grouped in a ring shape and the owls easily find concealment within these clumps, in spite of the fact that the clumps are surrounded for tens of feet by pure *Salicornia* that is usually only about six inches high.

FIG. 1. A tidal slough on San Pablo salt marsh. The slough is about 25 feet wide. In the center foreground *Spartina* is evident; along the slough banks grows *Grindelia*; the remainder of the vegetation is almost wholly *Salicornia*.

Numbers of the owls.—A trustworthy method of counting these birds was not developed. The behavior of the owls in the presence of an observer was highly unpredictable. They would not necessarily flush when an observer was as close as 20 yards from them. Those that did flew variously 50 to 500 yards. It was not always possible to determine the exact spot on the marsh where the birds alighted because the marsh is flat and diagnostic landmarks uncommon. Thus, when an owl was flushed, frequently it was difficult to know whether or not it had already been counted.

The best count of owls was made on December 26, 1951, when an extremely high tide covered everything on the marsh except the topmost six to ten inches of *Grindelia* branches and pieces of wood and other flotsam. The fauna of the marsh was pushed up to these dry posts and consequently was generally ill-concealed. Under these conditions the owls foraged conspicuously up and down the *Grindelia* rows. Normally the owls are nighttime feeders in this area, but during the high tides they spent a large amount of time in the air in daylight foraging. When they alighted, they were still

exposed to view on emergent posts and floating timbers. Four, and possibly five, owls were visible simultaneously at 11:30 a.m. on the day mentioned. Sibley (1955) recorded ten Short-eared Owls during a two-mile walk along a levee in salt marshes near Alviso, at the southern end of San Francisco Bay, under similar tidal conditions. Thus, since I had about 150 acres under observation, I saw possibly only half of the owls that were present on that day. The number of owls on San Pablo salt marsh in the winter may be taken at no less than four or five and probably no higher than eight or ten.

This broad estimate may well apply to all years of the study, since there is no evidence that 1951 was any different from the subsequent years with regard to the number of Short-eared Owls on the marsh. At the beginning and end of the winter period the density of owls is definitely less than that reached in midwinter.

Feeding Relationships

Foraging behavior.—My best observations on foraging behavior were made in daylight hours during high tides, as has been indicated. Yet the owls here are nocturnal foragers in the main, and my observations may not be wholly representative. The most common foraging method used is harrying flight. Harrying flight is effected by flying slowly along the course of a tidal slough and is punctuated by sudden drops to the level of the vegetation or ground surface after prey or to alight. Also, the owls occasionally sally forth after prey from their roosting places, or, more usually, from higher prominences.

The owls become active foragers about a half-hour before sunset, or somewhat earlier on overcast days. I do not know how much of the night is spent foraging, but it is unlikely that these birds differ much from other nocturnally-foraging Short-eared Owls in this respect. Normally they cease feeding by one hour after sunrise at most. Twice I have disturbed owls in the act of eating Dowitchers (*Limnodromus griseus*) in the middle of the afternoon, two and three hours before sunset.

A possible explanation for the almost complete absence of daytime feeding in this species that is known to hunt in the daytime as a rule on its breeding grounds and in certain parts of its winter range (Errington, 1932:178) is that gulls flock around the owls and mob them in flight. Species known to fly at the owls are the Glaucous-winged Gull (*Larus glaucescens*) and Ring-billed Gull (*L. delawarensis*); other gulls also participate. When attacked by the gulls, the owls invariably increase their flying altitude. The reasons for this seem obscure, for the extra altitude is not used by the owls for aerial maneuvers. I never saw a gull actually strike an owl; either the gulls

were content merely to come close, or the erratic, bouncy flight of the owls served to throw the gulls off course. But, there is no question that the owls were disturbed by the gulls.

Pitelka, Tomich, and Treichel (1955:112) reported that territorial Pomarine Jaegers (*Stercorarius pomarinus*) harried Short-eared Owls on the breeding grounds near Barrow, Alaska. The chasing was so severe that these observers were not certain just when the owls found time to forage unmolested, but they thought it was probably in the twilight hours when the jaegers possibly were not as alert as in the full light of day. Certainly the situation on San Pablo marsh is not as critical to the owls, and there is no territoriality involved, but it is worthy of note that daytime foraging of owls is absent and harrying by gulls occurs.

Prey items.—Although there is a good-sized literature on the food of Short-eared Owls in the breeding season (for example, Pitelka, Tomich, and Treichel, 1955; Errington, 1937) little information is available on their food in the winter in North America. Fisher (1893), Cahn and Kemp (1930), Errington (1932), and Tomkins (1936) report the largest winter samples of food items; Huey's (1926) report is the only one listed in Bent (1938) for western North America. It is, coincidentally, for a salt marsh locality but involves only two pellets.

On San Pablo salt marsh I picked up pellets of Short-eared Owls at irregular times and stations within an area of about 200 acres. No definite pattern was followed in picking up the pellets because the owls had no preferred casting spots and dropped pellets at random stations throughout the marsh. This made it difficult to get dates for most of the pellets. In the one instance of finding a true casting station only 32 pellets were found and these spanned a period in time of about three months.

A mammal was counted as occurring only on the basis of a skull; this avoided the possibility of duplication of individuals. Therefore, this count presents a minimum occurrence for the mammalian remains. In the case of birds, and especially small birds, occurrence of many bones and feathers in a pellet was taken to represent at least one bird, whether or not the skull was present. In point of fact, but one bird skull was found; the Short-eared Owl chops and mangles all of a bird's head except the bill, which it does not necessarily ingest. If an isolated long bone or a few feathers occurred in a pellet, the dominant remains in which were mammalian, no count was made of them. Any occurrence of insect hard parts was taken to represent one, or more, insect(s). From this it will be seen that a maximum occurrence of birds and insects is indicated in the tabulation, contrary to the situation in the mammals.

TABLE 1

FOOD ITEMS FOUND IN PELLETS OF THE SHORT-EARED OWL ON SAN PABLO SALT MARSH

	Absolute Occurrence	Frequency in per cent				
		1952	1953	1954	1955	Total
Microtus californicus	272	56.1	44.8	37.0	33.6	42.9
Rattus norvegicus	116	7.2	16.7	20.5	27.3	18.0
Reithrodontomys raviventris	56	8.4	7.0	11.5	6.9	8.6
Mus musculus	40	8.4	3.5	6.5	5.7	6.1
Sorex vagrans	17	6.1	2.6	1.0	1.3	2.6
Thomomys bottae	6	4.0	—	—	—	0.9
Scapanus latimanus	1	0.7	—	—	—	0.2
Mammals: total	508	90.9	74.6	76.5	74.9	79.8
Erolia-Ereunetes	21	1.0	6.2	4.5	3.8	3.2
Unidentified birds	17	—	3.5	4.5	1.3	2.6
Sturnella neglecta	15	1.0	0.9	3.0	3.8	2.2
Erolia minutilla	12	3.0	—	1.5	1.9	1.8
Passerculus sandwichensis	9	—	2.5	1.0	1.9	1.4
Ereunetes mauri	6	0.7	—	1.0	1.9	0.9
Erolia alpina	6	—	—	0.5	3.2	0.9
Limnodromus griseus	5	—	1.7	—	1.3	0.8
Melospiza melodia	4	—	0.9	1.5	—	0.6
Rallus longirostris	3	—	—	0.5	1.3	0.5
Anthus spinoletta	1	—	—	0.5	—	0.2
Pooecetes gramineus	1	0.7	—	—	—	0.2
Passerella iliaca	1	—	—	0.5	—	0.2
Birds: total	101	6.4	15.7	19.0	20.6	15.5
Stenopelmatus (sand-cricket)	28	2.0	8.8	4.5	3.8	4.7
Unidentified insects	3	0.7	0.9	—	0.7	0.5
Total	638	100.0	100.0	100.0	100.0	100.0

Table 1 presents the list of the occurrence of all the species and groups identified from the pellets. The gross breakdown shows about 75 per cent of the items to be mammals, 20 per cent birds, and 5 per cent insects. This is only a crude indication of the various groups as to their importance to owls as food, for the relative masses involved place the mammals as responsible for about 85 to 90 per cent of the food of the owls. Most of the mammals, and presumably also the birds, in the pellets were subadults, but this is true of most free-living populations of vertebrate animals in the period September to April.

In the discussion of the prey species, which follows immediately, I have attempted to indicate something of the relative numbers of the wild populations that are involved. I have relied on the number of occupied nests as

the major indication of mammal numbers; this type of information was gathered primarily in the spring, not in the early winter. With this as an index, none of the mammals on which I could gather data appeared to fluctuate in numbers. Probably it would be more realistic to say that the fluctuations that did occur were not large enough to be detected by my relatively crude techniques. As Table 1 shows, there were some important shifts in the occurrence of the mammals as prey items in the pellets from year to year. I would say that these shifts in occurrence reflect changes in population density possibly of similar direction and size.

As for the birds, they can be counted directly, especially in the breeding season, or otherwise simply dealt with. It has been possible to list their occurrence on the marsh as populations with some accuracy. This good fortune actually means little; in the first place, the incidence in the pellets of any one bird or group of birds is so slight that their fluctuations have little importance to the diet of the owls (see Table 1). In the second place, the density of the resident birds (mainly Song Sparrows) varies little (Johnston, MS), so that the owls have about the same number to choose from always. I cannot speak with the same assurance about the migrants.

The California vole (*Microtus californicus*) is the most numerous prey species found in the pellets. In 1952 it was also the most important animal to the owls in point of food mass furnished. In 1953, 1954, and 1955 the Norway rat (*Rattus norvegicus*) furnished the greatest bulk. The reduction of *Microtus* in the pellet samples after 1952 seems a significant trend in spite of the fact that the number of nests and fresh cuttings of the vole indicated a steady level of population density; probably there was a real drop in density. It should be noted that there may be some as yet undemonstrated relationship between the drop in *Microtus* and the rise in *Rattus* in the pellets.

Further, the incidence of *Microtus* in the pellets does not indicate this population to follow the regular and periodic fluctuations in density that have been described for microtines elsewhere. It is probable that *M. californicus* only three to four miles distant in the headwaters of Wildcat Creek shows the classic four year cycle (Robert Hoffmann, MS), yet the present data show a "high" in 1952 and a decrease every year since that time. 1955 should have been "high" again if this population were to parallel the classic cycle.

The Norway rat showed a steady rise in incidence of occurrence in the pellets. It remained, at its highest, second to *Microtus* in numbers, but was responsible for most of the food eaten by the owls. Since the rat lives successfully in the wild state on the marsh, and its numbers are constantly augmented by ingress of individuals from the nearby Richmond city dump,

it would be thought that its numbers would remain relatively constant. This is not true; at least, a four-fold increase in occurrence in the pellets seems to indicate a related increase in population density.

The occurrence of the other mammals in the pellets does not indicate annual variation in numbers. Possibly the numbers of shrews (*Sorex vagrans*) fluctuate, but the sample sizes are basically too small to make certain. However, there is little doubt that the salt marsh harvest mouse (*Reithrodontomys raviventris*) and the house mouse (*Mus musculus*) were taken by the owls at a steady rate.

The pocket gopher (*Thomomys bottae*) and the western mole (*Scapanus latimanus*) are not residents of San Pablo salt marsh but they occur nearby in cultivated fields and along San Pablo and Wildcat creeks, which flow through the marsh. The low incidence and sporadic occurrence of these mammals show that they are not important to the Short-eared Owls of San Pablo salt marsh.

About seven and one-half per cent of the items taken were migrant, charadriiform birds, and some four and one-half per cent were resident birds, mainly passerines. Within the limits of a small sample I consider these frequencies to be practically equivalent with one another. If it is borne in mind that, although the shorebirds at their peak density outnumber passerines by at times over 10 to 1, the shorebirds are transient and are never for long at a maximum density, then the practical equivalence of occurrence between them and the passerines seems reasonable. Table 2

TABLE 2

ESTIMATED NUMBERS OF RESIDENT AND MIGRANT BIRDS ON SAN PABLO SALT MARSH IN MIDWINTER[1]

RESIDENT BIRDS	
Clapper Rail, *Rallus longirostris*	about 30
Marsh Wren, *Telmatodytes palustris*	about 30
Western Meadowlark, *Sturnella neglecta*	possibly 50
Savannah Sparrow, *Passerculus sandwichensis*	about 150
Song Sparrow, *Melospiza melodia*	very near 450
Total	710
MIGRANT BIRDS	
Short-billed Dowitcher, *Limnodromus griseus*	up to 1000
Western Sandpiper, *Ereunetes mauri*	up to 1000
Red-backed Sandpiper, *Erolia alpina*	up to 1500
Least Sandpiper, *Erolia minutilla*	up to 5000
Total	8500

[1]The resident birds occupy about 200 acres; the migrants use this and in addition 500 to 1000 acres of intertidal mudflat.

presents a rough estimate of the density of these two groups of birds on 200 acres of salt marsh.

For the resident birds I arrived at the figures in the following manner: I know there are about 150 pairs of Song Sparrows in the breeding season and that these will produce about four fledglings per pair to make a total of about 900 birds at the late spring maximum. Of these, about 450 ought to be available to the owls in mid-December. Winter estimates (Table 2) based on 50 breeding pairs of Savannah Sparrows, 10 pairs of Clapper Rails, and 10 pairs of Marsh Wrens are 150, 30, and 30 individuals, respectively. About 50 Western Meadowlarks should be added to make a total of 710 birds. Earlier in the season there would be more, later in the season fewer, birds.

The migrant shorebirds occur sometimes in numbers as large as I have indicated, but I think usually the occurrence would be somewhat less. Certainly one-quarter to one-half of my estimate of 8500 would be a conservative indication of mean occurrence. These relatively vast numbers probably adequately account for the number of individuals taken by the owls. But, it must be remembered that on San Pablo marsh the Short-eared Owl is a nocturnal feeder; accordingly, it would be the roosting shorebirds on the high marsh that would be prey for the owls, and presumably these birds would be easy to catch. Therefore, it seems a little unusual that more were not taken. Perhaps this is further evidence of the already known preference of the Short-eared Owl for small mammals as food.

It should be mentioned that the Western Meadowlark does not live on the marsh but large numbers of them every day venture far out on the marsh in foraging. The Fox Sparrow (*Passerella iliaca*) probably was taken along the nearby Wildcat Creek. All other birds found in the pellets occur normally on the marsh, either as residents or migrants.

Relationships of Short-eared Owls to the Community

An accurate perspective on the impress made by the predation of an owl population can be gotten only through placing this predation properly in the setting of the community. The Short-eared Owl is influenced by the population dynamics, movements, and indeed the mere presence of virtually every animal species on the marsh. Many of the animal interrelationships are subtle, and some are doubtless yet unsuspected. My information on community interaction is almost wholly restricted to that relating to the food situation. The food relationships outlined in Figure 2 are those that I have become aware of in the course of studies on the population ecology of the Song Sparrow. Thus, except for the owl pellet samples and counts of resident birds, the details of the pyramidal structure of the community are purely qualitative. Fortunately, this community is a simple one and

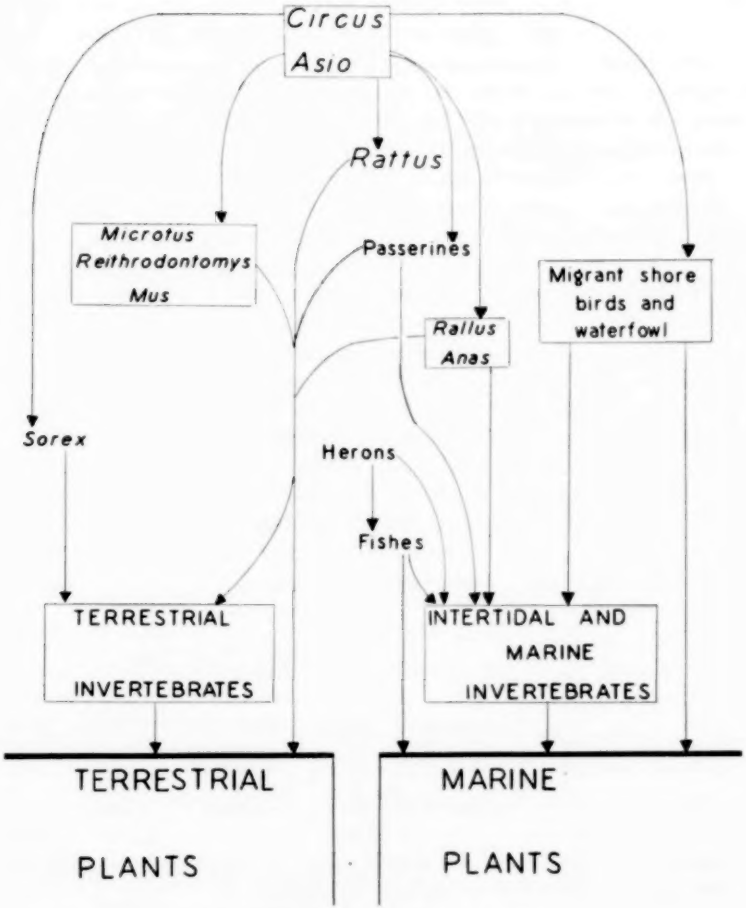

FIG. 2. The food web in winter on a *Salicornia* salt marsh.

the available information indicates the generalization represented by Figure 2 to be valid in all respects.

Several of the groups deserve comment and listing of the animals included. The groups are considered in order as they increase in total number of individuals.

Predators.—The Short-eared Owl has been discussed. Of the hawks only the Marsh Hawk (*Circus cyaneus*) was resident and of major importance.

One pair nested in a nearby *Spartina* area, producing two to four young each year. The winter population numbered four to six individuals.

Other hawks that hunted on the marsh were the Peregrine Falcon (*Falco peregrinus*) and the Merlin (*F. columbarius*). These two were seen but rarely. More commonly seen were the Sparrow Hawk (*F. sparverius*), Red-tailed Hawk (*Buteo jamaicensis*), and Sharp-shinned Hawk (*Accipiter striatus*); but these three were never seen to hunt on the marsh.

Four herons hunted on the marsh. The Common Egret (*Casmerodius albus*) and the Great Blue Heron (*Ardea herodias*) were the most important; the Black-crowned Night Heron (*Nycticorax nycticorax*) and the Snowy Egret (*Leucophoyx thula*) were less abundant and were present only in the late winter and spring. Probably some rodents were taken by these herons.

The Norway rat is the only mammalian predator of any importance on the marsh. It is known that the rat takes eggs and young of the Mallard (*Anas platyrhynchos*), Clapper Rail, Savannah Sparrow, and Song Sparrow. Probably it preys also on the young of the other, smaller mammals.

Secondary consumers.—This group includes those animals that stand in an intermediate position in the predator-food resource sequence. The box labeled, "Rallus/Anas" refers to the Clapper Rail and the Mallard; there are two pairs of nesting Mallards on the marsh.

Passerine birds may be broken down into two groups, as per the following lists:

Resident	Winter visitant
Telmatodytes palustris	*Anthus spinoletta*
Sturnella neglecta	*Pooecetes gramineus*
Passerculus sandwichensis	*Passerella iliaca*
Melospiza melodia	*Dendroica auduboni*
	Geothlypis trichas

Migrant shorebirds and waterfowl make up the bulk of the marsh avifauna during the winter period. In the following lists those species of most importance on the marsh are marked with an asterisk. All records are based on sight identification made in the field.

Waterfowl

Branta canadensis	*Aythya americana*
Branta bernicla	*Aythya marila*
Chen hyperborea	**Aythya affinis*
Anas platyrhynchos	*Bucephala clangula*
Anas carolinensis	*Oxyura jamaicensis*
**Anas acuta*	*Mergus serrator*
Mareca americana	**Fulica americana*
Aythya valisineria	

Shorebirds

**Squatarola squatarola*	*Capella gallinago*
Charadrius vociferus	*Crocethia alba*
Numenius phaeopus	**Ereunetes mauri*
Numenius americanus	**Erolia minutilla*
Limosa fedoa	**Erolia alpina*
Totanus flavipes	*Recurvirostra americana*
**Catoptrophorus semipalmatus*	*Lobipes lobatus*
**Limnodromus griseus*	

Of the fishes only the three-spined stickleback (*Gasterosteus aculeatus*) was found to be a permanent inhabitant of the creeks and ponds of the marsh. Utilizing the tidal creeks as foraging grounds during periods of high water, and occasionally becoming stranded when the water level dropped were the following species: northern anchovy (*Engraulis mordax*), jack smelt (*Atherinopsis californiensis*), top smelt (*Atherinops affinis*), and staghorn sculpin (*Leptocottus armatus*). The striped bass (*Roccus saxatilis*) probably also should be included in this list, but I did not find it; it would prey on shrimps and smaller fishes.

Terrestrial invertebrates.—This list is far from complete; many additions could be made, most probably among the insects.

Amphipoda	Insecta
Isopoda	Coleoptera
Arachnida	Lepidoptera
	Diptera

Intertidal and marine invertebrates.—Insects are here included by virtue of those species that live part of their lives in the quiet waters of ponds and occluded oxbows; the water in these sometimes is highly saline, due to evaporation.

Nemertea	Insecta
Polychaeta: Nereidae	Dysticidae
Ostracoda	Notonectidae
Copepoda	Diptera
Isopoda	Aspidobranchia
Amphipoda	Pectinibranchia
Decapoda	Filibranchia

The relationships diagrammed in Figure 2 hold only for the fall and spring months, when all the animals indicated would be present on the marsh. Especially in the summer the relationships would be markedly different. As an example, the insects are extremely abundant and the waterfowl and shorebirds are practically absent in summer. Actually, almost all the larger and conspicuous birds use other areas for breeding; the Short-eared Owl and the herons are included here. Thus, the fullest expression

of the relationships subsumed by the intertidal and salt marsh food web and pyramid of numbers is reached in the fall-to-spring period, for which Figure 2 is valid.

Summary

The Short-eared Owl is a common winter visitant to the salt marshes around San Francisco Bay. Between four and ten owls live in the winter on the study plot of some 200 acres on San Pablo salt marsh. The owls forage mainly at night there. Of 638 items found in pellets, 75 per cent were mammals, 20 per cent birds, and 5 per cent insects. Mammals were responsible for about 90 per cent of the mass consumed, *Microtus* and *Rattus* being the most important kinds. The relationship of Short-eared Owl predation to the community food web is indicated by means of a diagram.

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Museum of Vertebrate Zoology, Berkeley, California, July 13, 1955

BIRDS OF THE SWAN ISLANDS

BY RAYMOND A. PAYNTER, JR.

THE Swan Islands lie in the Caribbean Sea (Lat. 17°25′ N., Long. 83°56′ W.) about one hundred miles north of Punta Patuca, in eastern Honduras, the nearest point on the mainland, and nearly two hundred miles southwest of the Cayman Islands, the next nearest land. Swan Island, the larger of these low, coral islets, is slightly more than two miles long and about three-quarters of a mile wide; it is nearly rectangular. To the east, separated by less than a quarter of a mile of shallow water, is Little Swan Island, which is also roughly rectangular, but only a little more than a mile in length and about one third as wide.

According to Lowe (1909; 1911), both islands are covered by low forest, with the exception of parts of Swan Island which have been cleared for dwellings and extensive groves of coconuts. The number of species of trees enumerated by Lowe (1911) is notable, considering the isolation and small size of the islands. There is a small grassy area on Swan Island which was probably once a lagoon, although only a shallow area of fresh water remains in the center; this may disappear when rain is infrequent. From a description given by Delacour (1938), the vegetation seems not to have been further disturbed since Lowe's visit.

The first collection of birds from the islands was made by C. H. Townsend between February and March, 1887. The collection was studied by Ridgway (1888), who lists 30 species.

The next naturalist on the islands was Lowe, who remained there from mid-January to mid-February, 1908. He collected 18 species, saw an additional seven species, and from descriptions provided by the islanders tentatively records the following: *Anas discors*, *Anas crecca*, *Anas americana*, *Aythya valisineria*, *Gallinula chloropus*, *Columba squamosa*, *Tyrannus dominicensis*, and *Passerculus sandwichensis* (Lowe, 1909). In a later account (Lowe, 1911) he includes on the tentative list *Anas acuta* and *Anas clypeata*, two species not listed earlier, but omits *Anas discors* and *Anas crecca*. If it were not for the fact that *Anas discors* and *Tyrannus dominicensis* have since been reported from the islands, one might have disregarded the second-hand observations. All of these birds would not be unexpected on the islands; the failure of recent collectors to find more of the water birds may indicate that the pond has disappeared, or is rarely full enough to attract those species.

In 1912, George Nelson, of the Museum of Comparative Zoology, began a series of trips to the Swan Islands. Between February 25 and March 22, 1912, he collected 57 specimens, representing 19 species. From July 10 to 14, 1912, he took 13 specimens of two species. Finally, from April 8 to 19,

1913, five specimens of four species were secured. These collections contain much of importance, but no report was prepared. Bond's (1950*a*) record of *Limnothlypis swainsonii* from Swan Island is based on the specimen obtained by Nelson (Peters, 1913); none of the other records has been published.

In 1926 and 1927 the Museum of Comparative Zoology received single specimens of 18 species which were secured by Neal Wilson on the Swan Islands between September 25, 1926, and April 10, 1927. These birds are also of considerable interest but never were studied.

A. K. Fisher stopped at the islands from April 19 to 20, 1929, recording 21 species (Fisher and Wetmore, 1931). The last ornithologist to visit there appears to have been Delacour, who, on October 20, 1937, noted about a dozen forms, including several new to the islands (Delacour, 1938).

Annotated List

The following list contains all of the species known, with certainty, to have occurred on the islands. Those birds which have not been noted previously in publications are indicated by an asterisk (*). The collectors, or observers, of each species are listed and full data are presented for specimens in the collections of Nelson and of Wilson.

Sula leucogaster leucogaster (Boddaert). Brown Booby. Townsend; Lowe; Fisher; Delacour. Breeds on Little Swan Island.

Sula sula sula (Linnaeus). Red-footed Booby. Townsend; Lowe; Fisher; Delacour. Breeds on Little Swan Island.

Fregata magnificens rothschildi Mathews. Man-o'-War Bird. Townsend; Lowe; Fisher; Delacour. Breeds on Little Swan Island.

Ardea herodias subsp. Great Blue Heron. Fisher; Delacour. Sight records.

Florida caerula (Linnaeus). Little Blue Heron. Lowe. Sight record.

Butorides virescens virescens (Linnaeus). Green Heron. Townsend; Fisher; Delacour; Nelson (1 female, Apr. 8, 1 female, Apr. 18, 1913); Wilson (1 unsexed specimen, Sept. 25, 1926). Townsend collected specimens on March 6 and 26, 1887, and Fisher one on April 19, 1929. The fact that Lowe did not find the species in mid-winter probably indicates that it is a transient. Fisher and Wetmore (1931) reached the same conclusion when discrediting *B. v. saturatus*, which Ridgway (1887) described from Swan Island.

**Nyctanassa violacea violacea* (Linnaeus). Yellow-crowned Night Heron. Nelson (1 male, Apr. 14, 1913).

Botaurus lentiginosus (Rackett). American Bittern. Lowe. Sight record.

Anas discors Linnaeus. Blue-winged Teal. Delacour. Sight record.

Pandion haliaetus subsp. Osprey. Lowe. Sight record.

Falco peregrinus anatum Bonaparte. Peregrine Falcon. Townsend; Lowe.

Falco columbarius columbarius Linnaeus. Pigeon Hawk. Townsend; Lowe; Fisher.

Falco sparverius subsp. Sparrow Hawk. Delacour. Sight record.

Porzana carolina (Linnaeus). Sora. Townsend.

**Fulica americana americana* Gmelin. American Coot. Wilson (1 male, Dec. 25, 1926).

**Charadrius hiaticula semipalmatus* Bonaparte. Ringed Plover. Wilson (1 male, Oct. 11, 1926).

Charadrius wilsonia subsp. Thick-billed Plover. Lowe. Sight record.

Arenaria interpres morinella (Linnaeus). Ruddy Turnstone. Lowe; Nelson (1 female, Mar. 2, 1912); Wilson (1 unsexed specimen, Oct. 9, 1926).

Tringa flavipes (Gmelin). Lesser Yellow-legs. Townsend; Nelson (1 female, Mar. 13, 1912); Wilson (1 female, Feb. 19, 1927).

Actitis macularia (Linnaeus). Spotted Sandpiper. Delacour. Sight record.

Calidris pusilla (Linnaeus). Semipalmated Sandpiper. Townsend.

Calidris melanotos (Vieillot). Pectoral Sandpiper. Townsend.

**Sterna fuscata fuscata* Linnaeus. Sooty Tern. Wilson (1 male, Oct. 4, 1926). The failure of earlier collectors to record this species, and the apparent lack of suitable nesting localities on the islands, suggest that Sooty Terns are visitants only.

Columba leucocephala Linnaeus. White-crowned Pigeon. Townsend; Lowe; Fisher; Delacour; Nelson (3 males, 3 females, Feb. 28 to Mar. 22, 1912). White-crowned Pigeons breed on both islands. The species is migratory in the northern section of its range and possibly part of the winter population on the Swan Islands is composed of visitants. There is no evidence of this, but the lack of evidence is of little significance since the data are scant; even the date of the nesting season is unrecorded.

Coccyzus minor nesiotes Cabanis and Heine. Mangrove Cuckoo. Townsend; Nelson (1 male, Mar. 1, 1912); Wilson (1 female, Oct. 11, 1926; 1 female, Apr. 10, 1927). The Mangrove Cuckoo is presumed to breed, but it should be noted that Lowe (1909) failed to record the bird in mid-winter, which implies that it may be only a transient. The recent discovery (Voous, 1955) that *C. m. maynardi*, a contiguous race to the north of *C. m. nesiotes*, is a visitor on Curaçao and Bonaire makes this seem more probable.

Coccyzus americanus americanus (Linnaeus). Yellow-billed Cuckoo. Townsend.

Crotophaga ani Linnaeus. Smooth-billed Ani. Lowe; Delacour; Nelson (2 females, Mar. 1, 1912). Lowe (1911) has made the plausible suggestion that since Townsend failed to take any specimens of the ani, the species probably became establishd on the islands sometime after 1887. Although Townsend may have neglected to collect anis, this seems improbable in view of the fact that he even collected series of boobys and frigate birds, species which are often purposely slighted by selective collectors. In further support of his idea, Lowe (1909; 1911) points out that the islands were heavily wooded until the mid-1800's when the first settlers arrived, and that it is unlikely that anis would have found an adequate habitat prior to the creation of clearings. Similar situations are known, with fair certainty, to have occurred on Tobago Island, where *Crotophaga ani* arrived in 1822 or 1823 (Kirk, *in* Jardine, 1840), and on the islands of San Andrés and Providencia, where the species became established within recent years (Bond, 1950*b*).

Chordeiles minor gundlachii Lawrence. Common Nighthawk. Fisher. A migrant.

Ceryle alcyon subsp. Belted Kingfisher. Lowe; Fisher. Sight records.

**Sphyrapicus varius varius* (Linnaeus). Yellow-bellied Sapsucker. Nelson (1 female, Mar. 7, 1912).

Tyrannus tyrannus (Linnaeus). Eastern Kingbird. Townsend.

**Tyrannus dominicensis dominicensis* (Gmelin). Gray Kingbird. Wilson (1 male, Mar. 30, 1927). This flycatcher is probably a transient since no other collector has found it.

Contopus virens virens (Linnaeus). Eastern Wood Pewee. Townsend; Fisher.

Iridoprocne bicolor (Vieillot). Tree Swallow. Delacour. Sight record.

**Riparia riparia riparia* (Linnaeus). Bank Swallow. Wilson (1 female, Mar. 26, 1927).

Hirundo rustica erythrogaster Boddaert. Barn Swallow. Townsend; Fisher; Wilson (1 male, Mar. 19, 1927).

**Petrochelidon pyrrhonota pyrrhonota* (Vieillot). Cliff Swallow. Wilson (1 male, Mar. 21, 1927).

Dumetella carolinensis (Linnaeus). Catbird. Townsend; Lowe; Fisher; Nelson (3 males, 2 females, Mar. 15 to 22, 1912).

Mimocichla plumbea rubripes (Temminck). Western Red-legged Thrush. Townsend collected ten specimens, but the bird has not been observed since. It is presumed to have been extirpated, possibly owing to the disturbance of the forest.

Catharus ustulatus swainsoni (Tschudi). Olive-backed Thrush. Fisher; Wilson (1 male, Oct. 22, 1926).

**Catharus minimus minimus* (Lafresnaye). Gray-cheeked Thrush. Nelson (1 female, Apr. 19, 1913).

Vireo griseus noveboracensis (Gmelin). White-eyed Vireo. Lowe.

**Vireo flavifrons* Vieillot. Yellow-throated Vireo. Nelson (1 female, Mar. 14, 1912).

Mniotilta varia (Linnaeus). Black-and-white Warbler. Townsend; Lowe; Fisher.

Limnothlypis swainsonii (Audubon). Swainson's Warbler. Nelson (1 female, Mar. 1, 1912). This specimen appears to have been the one cited by Bond (1950*a*).

Helmitheros vermivorus (Gmelin). Worm-eating Warbler. Lowe; Nelson (1 male, Mar. 1, 1912).

Parula americana pusilla (Wilson). Parula Warbler. Townsend; Nelson (1 female, Feb. 28, 1912).

**Dendroica tigrina* (Gmelin). Cape May Warbler. Nelson (1 male, Mar. 22, 1912).

Dendroica caerulescens caerulescens (Gmelin). Black-throated Blue Warbler. Townsend; Fisher; Nelson (1 female, Feb. 29, 1912).

Dendroica coronata coronata (Linnaeus). Myrtle Warbler. Townsend; Lowe; Nelson (3 females, Mar. 14 to 22, 1912).

Dendroica fusca (Müller). Blackburnian Warbler. Fisher. Sight record.

Dendroica dominica dominica (Linnaeus). Yellow-throated Warbler. Nelson (1 female, Feb. 29, 1912).

Dendroica discolor discolor (Vieillot). Prairie Warbler. Townsend.

Dendroica vitellina nelsoni Bangs. Vitelline Warbler. Townsend; Lowe; Fisher; Delacour; Nelson (11 males, 12 females, 1 unsexed specimen, Feb. 25 to Mar. 12; 6 males, 5 females, 1 unsexed specimen, July 10 to 12, 1912). This is the only breeding passerine on the islands and also the only endemic form.

Dendroica palmarum palmarum (Gmelin). Palm Warbler. Townsend; Lowe; Nelson (1 female, Feb. 28, 1 male, Mar. 2, 1912).

Seiurus aurocapillus aurocapillus (Linnaeus). Ovenbird. Townsend; Nelson (1 unsexed specimen, Feb. 28, 1 male, Mar. 22, 1912); Wilson (1 unsexed specimen, Mar. 15, 1927).

**Seiurus motacilla* (Vieillot). Louisiana Waterthrush. Nelson (1 female, July 14, 1912). This is an unusually early date for the species to be so far south.

Seiurus noveboracensis notabilis Ridgway. Northern Waterthrush. Townsend; Wilson (1 unsexed specimen, Sept. 28, 1926).

Geothlypis trichas brachidactyla (Swainson). Common Yellowthroat. Townsend.

**Wilsonia citrina* (Boddaert). Hooded Warbler. Wilson (1 male, Mar. 25, 1927).

Setophaga ruticilla (Linnaeus). American Redstart. Townsend; Lowe; Fisher; Nelson (1 female, Feb. 29, 1912); Wilson (1 female, Oct. 9, 1926).

**Icterus spurius spurius* (Linnaeus). Orchard Oriole. Nelson (1 male, Apr. 17, 1913).
**Dolichonyx oryzivorus* (Linnaeus). Bobolink. Wilson (1 male, Oct. 2, 1926).
Piranga rubra rubra (Linnaeus). Summer Tanager. Fisher.
Spiza americana (Gmelin). Dickcissel. Townsend; Fisher.

Discussion

There is little doubt that wanderers or hurricane-wafted strays reach the Swan Islands with some regularity. However, owing to deficient numbers, because of an incompatible habitat, or for a number of other reasons, most species are unable to become established. Indeed, even on larger and ecologically more diverse oceanic islands, successful colonization is not common, as indicated by their depauperate avifaunas. The fortuitous manner by which the Swan Islands were populated is vividly evident. Of the 65 species recorded from there, only seven or eight are resident. Three of these (*Sula leucogaster*, *Sula sula* and *Fregata magnificens*) are marine and five (*Columba leucocephala*, *Coccyzus minor* [resident ?], *Crotophaga ani*, *Mimocichla plumbea*, and *Dendroica vitellina*) are land forms. It is interesting to speculate on the origin of the latter group.

Columba leucocephala disperses widely after the breeding season, which undoubtedly has led to its colonizing even the remote islands of the western Caribbean region. Its presence on the Swan Islands is in no way unusual.

Coccyzus minor nesiotes is a race found also on Jamaica, the Cayman Islands, Hispaniola, and other islands in the vicinity. If it is resident on the Swan Islands, it could most easily have arrived from Jamaica or the Cayman Islands, possibly through the agency of hurricanes. Its failure to differentiate in the manner of other isolated populations of the species, as, for example, those on San Andrés and Providencia islands, may be attributed to its recent arrival or, possibly, to genetic swamping by frequent immigrants. An alternate and more simple explanation may be that the bird is merely a transient on the islands.

Crotophaga ani, which apparently arrived between 1887 and 1908, seems to have been quick to exploit a newly created habitat, considering that the nearest source of immigrants is 200 miles across the Caribbean. If the lack of open fields had prevented Smooth-billed Anis from inhabiting the Swan Islands, and if clearings were first made about 1850, then colonization must have occurred within a maximum of fifty years after the habitat was altered; it could have occurred within half that time. This suggests that these isolated islands receive stray anis frequently, or that it was merely a matter of chance that the species should arrive so promptly. No matter which proposal is correct, the ani undoubtedly colonizes with more ease than many species, since it is highly social and several birds may wander, or be blown, to an

island at one time, thereby facilitating the establishment of a breeding population.

The former presence of *Mimocichla plumbea rubripes*, a race found on the Isle of Pines and in central and western Cuba, is unexpected. Assuming that the source of Townsend's specimens is correctly indicated, which is reasonably certain, one must accept the Cuban or Isle of Pines origin of the Swan Islands population. The birds may have been carried there by the northeastern trade winds, or they may have been swept to sea by hurricanes and later wandered to the Swan Islands. Thrushes are secretive and seem among the species most unlikely to colonize an isolated island. Nevertheless, they are distributed widely and have reached even as remote a place as Gough Island, in the South Atlantic. In this light, the presence of a thrush on the Swan Islands is not extraordinary.

Dendroica vitellina is restricted to the Cayman and Swan Islands. The Swan Islands endemic, *D. v. nelsoni*, was certainly derived from Cayman Islands stock. Hurricanes often sweep across the Caribbean in a path ideally suited to dispersal in this pattern.

The fact that 57 species have been recorded as migrants or visitants on the islands, in spite of scattered and infrequent observations, makes it obvious that migration across the Caribbean in the vicinity of the Swan Islands is of considerable magnitude. The presence of so many migrants cannot be accidental and suggests that the islands are on a migration route.

The available data are not sufficient to be confident of differentiating all of the visitants from all of the migrants. Therefore, if the discussion is confined to species which are not known to winter in the West Indies, we are left with the following 12 birds, which are certainly transients on the islands: *Chordeiles minor gundlachii*, *Tyrannus tyrannus*, *Contopus virens*, *Riparia r. riparia*, *Petrochelidon p. pyrrhonota*, *Catharus ustulatus swainsoni*, *Catharus m. minimus*, *Dendroica fusca*, *Wilsonia citrina*, *Icterus spurius*, *Dolichonyx oryzivorus*, and *Spiza americana*. Only *Riparia r. riparia* and *Dolichonyx oryzivorus* are found regularly east or south of the northern West Indies, indicating that most of the species on the list reach the mainland by some route other than through the chain of Greater and Lesser Antilles.

Tyrannus tyrannus, *Petrochelidon p. pyrrhonota*, *Catharus ustulatus swainsoni*, *Catharus m. minimus*, and *Dendroica fusca* winter exclusively in South America but do not occur on migration in the Lesser Antilles. In order to reach their winter quarters from the northern West Indies they must cross the open Caribbean. Since the Swan Islands are well to the west of a direct route from the Greater Antilles to South America, yet they receive migrants destined for South America as well as other migrants, it is logical to conclude

that they lie on a migration path extending from the northern Antilles to northern Central America. The five species under consideration occur in Central America but, unfortunately, all are known to migrate through Middle America, as well as via the West Indies. This has obscured the northern trans-Caribbean migration route and led to the generalized assumption (*e.g.*, Lincoln, 1950) that south-bound (or north-bound) birds migrate through Middle America or through the West Indies, but seldom utilize sections of both routes.

From the list of migrants found on the Swan Islands, it can be seen that not only do birds which winter in South America use this path, but also species which winter in Central America. When longer and more detailed studies have been made in the Caribbean, it may be found that the Greater Antilles–Central America route is fully as important as that between the Greater Antilles and South America.

Summary

Sixty-five species of birds have been recorded from the Swan Islands. Seven or eight are resident; three are marine (*Sula l. leucogaster*, *Sula s. sula*, and *Fregata magnificens rothschildi*) and five are land forms (*Columba leucocephala*, *Coccyzus minor nesiotes* [resident ?], *Crotophaga ani*, *Mimocichla plumbea rubripes*, and *Dendroica vitellina nelsoni*.

The thrush, whose origin was in Cuba or the Isle of Pines, was extirpated between 1887 and 1908; the ani arrived within the same period. Deforestation may have been responsible for both events.

The only endemic is *Dendroica v. nelsoni*, which was derived from Cayman Islands stock.

The presence of many migrants suggests the occurrence of large-scale migration between the northern Antilles and Central America.

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DISTRIBUTION OF THE CARDINAL IN SOUTH DAKOTA

BY HERBERT KRAUSE AND SVEN G. FROILAND

THE extension of the range of the Cardinal (*Richmondena cardinalis*) and its seasonal status in the upper Midwest apparently have received little attention in ornithological literature. This seems particularly true of the area bordering the upper Mississippi River in Minnesota and the Missouri River in South Dakota. Roberts (1936:335) states that by 1936 this species was established in Minnesota but was "confined as a resident breeding bird to the southeastern portion of the state." However, he found that it was "extending its range northward and westward."

In South Dakota, Visher (1915:332) reported the Cardinal as "a tolerably common resident in the Missouri Valley near Vermillion" (Clay County) by 1913. Five years later, according to Stephens (1918:101) it had "become very well established as a permanent resident" in Union County. Both Clay and Union counties are located in the extreme southeastern part of the state. Few reports of the Cardinal in South Dakota appeared subsequently, and, as late as 1930, Stephens observed (pp. 365–366): "It would be very interesting to know how far up the Missouri River these birds have extended their range at the present time; and also how far up the tributaries in this region they have penetrated." This study has been undertaken in an effort to throw light on some of these queries.

In order to obtain as broad a presentation of data as possible, the historical background was searched and the items in Stephens' (1945) bibliography and in the available literature checked. In addition to notes and observations of some seven years of personal field work, the writers interviewed and corresponded with competent observers located in strategic positions in the state. These persons' generous reports and comments are gratefully acknowledged. Those of Art Lundquist, Alfred Peterson, Ruth Habeger and V. H. Culp have been especially helpful.

The literature on the Cardinal in South Dakota is admittedly scanty. The scarcity of observers and collectors may be held responsible for many of the gaps in the information on this species. It was not listed in the journal of Audubon (1900), who was on the Missouri in 1843, nor was it included in Baird's (1858) list of the railroad survey made during the period 1853–56. The first record seems to have been that of McChesney (1879:78), who observed a pair at Fort Sisseton in the extreme northeastern part of the state in the spring of 1877. During that summer he saw a male several times. Neither collection nor nesting data was reported, however.

McChesney (*op.cit.*) remarked that the Cardinal was "only of casual occurrence in this region." However, it is possible that these individuals

were accidental rather than casual. It is not unusual for a Cardinal to appear far from its accustomed range. Roberts (1936:335) speaks of a male Cardinal reported in Minnesota in 1930 some 300 miles north of any previous record.

It may be significant that in the 75 years following McChesney's report of them, no further mention seems to be made of appearances of Cardinals in the vicinity of Fort Sisseton or in the northeast generally. Agersborg, whose list (1885) is the first important published record for the state by a resident, does not include it either for the state as a whole or for the southeastern part of the state. Larson (1925) did not list the Cardinal in his 10-year study (1906–1916) of the east-central area centering about Minnehaha County. Alfred Peterson, whose field work and publications began in the early 1920's, writes (letter, October 15, 1954) that he has never seen the Cardinal in the central northeastern region. Art Lundquist (letter, October 12, 1954), a veteran field man in the northeast area adjacent to the Fort Sisseton country, does not include occurrences until 1950 and does not report nesting data at this writing.

Though the Cardinal was noticed first in the 1870's, what seems to have been the first report of a Cardinal nest in South Dakota and perhaps the first indication of permanent residence in the state did not appear until after the turn of the century. In 1902 D. H. Talbot published a note regarding the breeding of this species in Union County, not far from Sioux City, Iowa (Fig. 1). Ten years later Visher (1915) noted it as "tolerably common in the Missouri Valley near Vermillion." This represents an advance upstream of some 40 miles. By the second decade, its nesting range seems to have included only the two counties in the extreme southeastern part of the state.

At the same time, as a winter bird, the Cardinal was appearing farther and farther up the Missouri. In the early 1920's it was found at Yankton, 50 miles upstream from Sioux City. In the 1930's it continued its march. In fact, during the period from 1930 to 1946, it apparently extended considerably its winter range in all the eastern part of the state. This species was making headway not only on the Missouri, but also on the James and the Big Sioux rivers, tributaries which drain a major share of the eastern half of the state. Reports of its appearances were noted from the Missouri on the south to the North Dakota border on the north. As early as the winter of 1929 Larrabee mentioned it as a December visitant in Minnehaha County, which is traversed by the Big Sioux. In the spring of 1937 Dr. J. F. Brenckle banded an individual in Spink County, 260 miles up the James River. In the years 1940–42 it appeared as a winter bird in those northeastern counties bordering on North Dakota. This brought it again into the Fort Sisseton area where McChesney had seen it some 75 years before. In some forty-odd

years then, it had traversed the eastern portion of the state from south to north. What is more, apparently this area became familiar ground. In the years following the middle 1940's the Cardinal has been reported fairly regularly in the northeastern portion of South Dakota. In 1954 wintering individuals were reported at Mobridge in the Missouri bottoms, which brings this species to within 30 miles of the North Dakota border in the north-central portion of the state also.

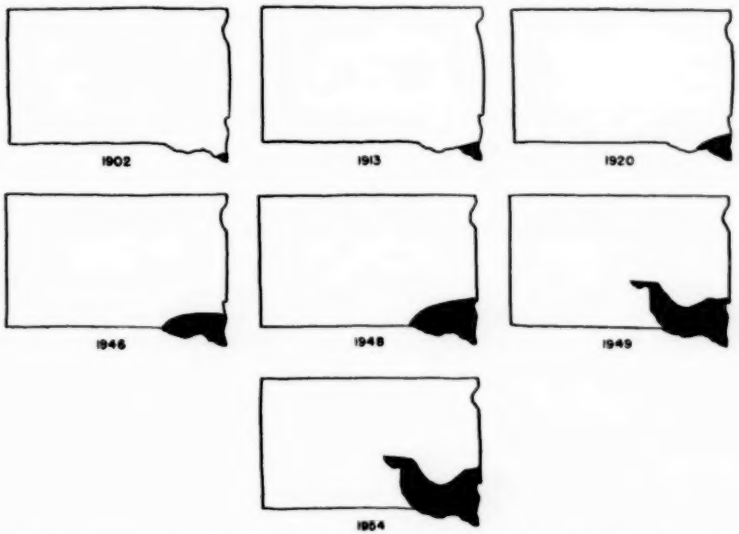

FIG. 1. Extension of the breeding range of the Cardinal in South Dakota based on available nesting records.

However, all these northern occurrences were recorded in fall, winter and early spring, and most involved male birds only. No summer records are available in spite of search by field men such as Lundquist and Peterson.

Meanwhile the breeding range of the Cardinal was advancing northward also. Randall (1953) found nests and young in the Fort Randall (Pickstown) locality in 1946, a 72-mile advance up the Missouri and some 125 miles from Sioux City. In 1950 a nest was reported at Fort Thompson, 100 miles north of Fort Randall. At present (1954) the Cardinal is reported nesting in the river bottoms at Farm Island and at Pierre, some 260 miles upstream from the place in Union County where the first nest was found. This, according to present evidence, is its farthest penetration up the Missouri as a breeding bird.

In the eastern part of the state, Krause in 1948 found two nests and eggs at Sioux Falls, Minnehaha County, an advance of about 80 miles up the Big Sioux River. Since 1948 there have been many reports of nests, eggs, young and juveniles in this area (Froiland, Krause and others). The Cardinal is common the year around in Minnehaha County, and it is continuing to spread northward. According to Ruth Habeger (letter, October 29, 1954) it nests regularly in Lake and Moody counties just north of Minnehaha County, an advance in six years of some 40 miles northward along the Big Sioux River. On the basis of available data, this represents its farthest penetration northward as a breeding bird and perhaps as a permanent resident. Thus in half a century, the breeding range of the Cardinal has advanced some 100 miles northward in the eastern part of South Dakota.

Habitat Distribution

A study of the distribution map (Fig. 2) suggests that the main streams and their tributaries played a part in the widening range of the Cardinal in South Dakota. In almost every instance the reports come from localities on fairly large streams or their tributaries. There are no reports of Cardinals from areas of high land between watersheds. Neither is there information on appearances or nesting on the wide prairies or the hill counties or along the small prairie tributaries of larger streams with their somewhat less abundant vegetation. Few records come from counties which have intermittent streams and which therefore seem to offer less cover and fewer nesting possibilities.

It is perhaps significant that McChesney's sight record of the Cardinal occurs at Fort Sisseton, for this military post was in the lake country in that portion of the northeastern part of the state which is drained by the tributaries of the Big Sioux River and which lies some 200 miles north—almost straight north—of the point where the Big Sioux empties into the Missouri.

Evidently the vegetation bordering these waterways offers the type of habitat suitable for nesting and cover. Generally, in the adjacent areas appear shrubby willow (*Salix* sp.), plum-choke cherry (*Prunus* sp.) and dogwood (*Cornus* sp.) over which in many places tower cottonwood (*Populus deltoides*) and American elm (*Ulmus americana*), hackberry (*Celtis occidentalis*) and boxelder (*Acer negundo*), basswood (*Tilia americana*) and ash (*Fraxinus lanceolata*) trees. Vines, such as wild grape (*Vitis vulpina*) and Virginia creeper (*Parthenocissus quinquefolia*), occur in some localities. This kind of habitat provides not only shelter for the Cardinal but food as well.

Extension of the Cardinal's Range Westward

It is curious that appearances of the Cardinal have been singularly lacking in the area west of the Missouri River. At least available records fail to report them. Visher (1909) does not include this species in his comprehensive "List of the Birds of Western South Dakota" which takes into account the observations of Hayden on the Warren Expeditions in 1857 and 1869, and the Grinnell report on the Custer Expedition of 1874, as well as the reports of such competent observers and collectors as Lee, Sweet, and Behrens, whose collections are still available. The region covered by Visher's "List" includes the Bad Lands and the Black Hills with the adjacent areas. The

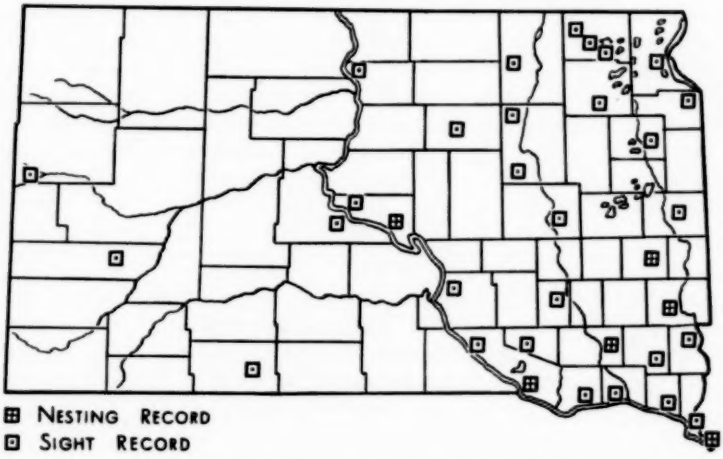

Fig. 2. Distribution of the Cardinal in South Dakota based on available records, 1875–1955.

Cardinal was not found on the Pine Ridge Reservation during Tullsen's (1911) stay there (1901–1908) nor was it seen by Visher (1912) during his survey (in 1908) of the area which also included a good portion of the White River drainage system.

Much of this region is semi-arid in character. The streams for the most part are intermittent and even those which persist during the greater part of the year are generally saline. While streams in the Black Hills are freshwater, they too are frequently intermittent. Plants which produce bushy thickets or viny tangles are not as abundant as in the east nor do they appear as regularly. It may be that the area, including as it does both the Black Hills and the Bad Lands, offers a complex of factors which might

be operative here—factors which involve unusual and often puzzling floral and faunal distribution patterns.

The first mention of the Cardinal in western South Dakota appeared in the literature in 1951, when Haight reported two Cardinals seen near Belle Fourche on the Cheyenne River in the northwestern part of the state. In the early spring of 1955 two occurrences were observed, one by Hyde (1955) in Rapid Canyon near Rapid City in the Black Hills and one by Krumm (1955) at La Creek Wildlife Refuge on the Nebraska border in the southwest. All three appearances were in winter and early spring and involved males. Considering the non-migratory behavior of this species and its sporadic appearances, one wonders whether these individuals came from the Missouri, following its tributaries, the Cheyenne in the north, the White in the south. There is also the possibility that the southern birds came from another tributary of the Missouri, the Niobrara River in Nebraska. At any rate, according to the data, the Cardinal has appeared west of the Missouri three times, all within the last five years. It will be interesting to see whether in the next 20 or 30 years it will increase in numbers as it did east of the Missouri with the possibility of finally establishing itself as a permanent resident in this western region.

Summary

1. During the past 52 years the Cardinal has extended its range as a breeding bird into eastern South Dakota. The initial entry was made in the southeastern portion and to the present time it is distributed approximately over the eastern one-fourth of the state.

2. During this time it has appeared as a wintering bird in appreciable numbers in various places outside the breeding range in the eastern part of the state.

3. The extension of range of the Cardinal closely parallels major rivers and their tributaries. It would appear that these streams play an important role in the immigration of this species by contributing suitable habitat.

4. The Cardinal has not been reported in the area west of the Missouri until very recently. This peculiarity in distribution may be the result of lack of suitable habitat on the frequently-intermittent streams and their tributaries in the Bad Lands–Black Hills region and in the adjacent areas.

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DEPARTMENT OF ENGLISH AND DEPARTMENT OF BIOLOGY, AUGUSTANA COLLEGE, SIOUX FALLS, SOUTH DAKOTA, MAY 16, 1955

ROOSTING AND NESTING OF THE GOLDEN-OLIVE WOODPECKER

BY ALEXANDER F. SKUTCH

THE Golden-olive Woodpecker (*Piculus rubiginosus*) is to my eye one of the most beautiful members of its family. Its back and wings are a most attractive shade of olive-green with a golden cast. The under parts are yellowish-olive with transverse yellowish bars; and the tail is brownish-olive, its central feathers becoming black at the tip. As with most woodpeckers, male and female are alike in appearance except for the markings of their heads. The male wears a large, bright crimson patch on his nape. This color extends forward along the sides of the crown to the base of the bill and encloses the slate gray of the forehead and center of the crown. His grayish cheeks are bordered below by broad, crimson malar stripes. The female has a large patch of crimson on her nape but lacks the conspicuous malar stripes of the male. About eight inches in length, these are woodpeckers of medium size.

The species has a vast range from México to northern Argentina and is highly variable, with many named races. I found the race *differens* fairly abundant in the coffee plantations on the Pacific slope of Guatemala, where the trees of the original forest had been left to shade the coffee which was set out after the undergrowth was cleared away and the canopy thinned. In October these woodpeckers were usually in pairs and rather difficult to approach. The Costa Rican form (*uropygialis*) is most abundant in the highlands. Carriker (1910. *Ann. Carnegie Mus.*, 6:584) found it ranging from 1500 to 6000 feet above sea level, but in greatest numbers between 2000 and 4000 feet, in the Reventazón Valley on the Caribbean side of the country. But in the region of El General on the Pacific slope I have never met it as low as 3500 feet. In the vicinity of Vara Blanca on the northern or Caribbean side of the Central Cordillera, the Golden-olive Woodpecker was rather rare at 5500 feet. Here I met it in the heavy, epiphyte-laden forest and in adjacent clearings with scattered trees.

Sleeping Habits

The first Golden-olive Woodpecker that I found at Vara Blanca was discovered one evening in August, as I made the rounds of the dead trunks standing in a pasture amid the forest, trying to learn what birds slept in the numerous cavities they contained. When I tapped on a low trunk with a woodpecker's hole in its side, a female of this species stuck her head through the doorway to see what was causing the disturbance. I attempted to make her come into the open; for I wished to see enough of her plumage

to identify her with certainty, and also to learn whether perchance a mate was in the hole with her. But although her chamber was only 20 feet high, she was not easily frightened into leaving it. Neither by hammering and tapping on the trunk—all that the tottering stub seemed capable of withstanding—clapping my hands, nor throwing up my cap, could I persuade her to quit her snug retreat.

But the following evening, August 20, 1937, I watched for her to enter her dormitory. The mountain was shrouded in clouds and a fine drizzle fell. At 5:10 p.m., she flew up to the trunk and entered without hesitation, although I stood fairly near and unconcealed. She slept alone in her trunk in the pasture, only a few paces from the forest's edge. This was her nightly lodging for the next two months.

I was absent from Vara Blanca during much of November and December. After my return in January, 1938, I found that the upper half of the low stub in which the woodpecker slept had fallen, and with it her bedroom. She now slept in a hole only head-high above the ground, in a low, slender stub in the midst of the pasture, up the slope from her former dormitory. This cavity had been the lodging of a female Hairy Woodpecker (*Dendrocopos villosus*), which had abandoned it before the Golden-olive Woodpecker's first hole fell (see Skutch, 1955. *Wilson Bull.*, 67:25–32). Early in March, I discovered that a male Hairy Woodpecker slept in a freshly carved hole in the top of the same low stub, about six feet above the old cavity in which the Golden-olive Woodpecker still roosted, and on the same side of the trunk. But before the end of the month, the female Golden-olive Woodpecker was lodging in the newer and higher hole, the Hairy Woodpecker having gone elsewhere. I do not know whether his desertion was voluntary, or whether his bigger neighbor had somehow evicted him, possibly merely by ensconcing herself within before his arrival in the evening. The lower hole in this trunk was now without a tenant.

Voice

About the middle of February, I began to hear, especially in the early morning, the far-carrying challenge of the male Golden-olive Woodpecker. This was a high-pitched, clear, powerful note, repeated very rapidly to form a long-continued roll or trill, all in approximately the same key. It was quite distinct from the shorter, weaker, slower roll of the Hairy Woodpecker, and from the queer, little, wooden rattle of the Smoky-brown Woodpecker (*Veniliornis fumigatus*), which were the chief picarian neighbors of our species at Vara Blanca. Clinging in some high tree-top, the Golden-olive Woodpecker repeated his loud trill over and over.

The call-note of both sexes is a high, loud, sharp *beee*; and they utter also a dry *churr*.

Incubation

On April 5, 1938, I learned that the Golden-olive Woodpeckers were incubating in the hole where the female had of late been sleeping, and where the male Hairy Woodpecker had formerly passed his nights. Since this cavity was 13 feet above the ground in a slender and exceedingly rotten stub standing amid tall, rank grasses in a steep hillside pasture, I could not reach it to look in without assistants to hold a ladder; and two days passed before these could be enlisted. When the interior had been illuminated by introducing a small bulb attached to an electric torch by means of a flexible cord, the mirror stuck through the doorway revealed four beautiful, glossy, pure white eggs, resting upon clean chips on the bottom of the cavity. I did not jeopardize the nest by attempting to remove them for closer examination.

Now that the female woodpecker's former dormitory had been converted into a nest, the male occupied it by night and kept the eggs warm, as is the custom of all the woodpeckers which sleep singly, so far as I know. The female returned to sleep in her earlier lodging six feet lower in the same stub, but only for a few nights, after which she moved to a more distant abode which I failed to find. In using the female's rather than the male's dormitory as a nest, the Golden-olive Woodpeckers did just the reverse of a pair of Red-crowned Woodpeckers (*Centurus rubricapillus*) whose habits I studied during two years in southern Costa Rica. With this pair, the male was the more industrious hole-carver and usually provided himself with a lodging far more substantial than that of his mate, who was often content to sleep in cavities which he had deserted as no longer fit to occupy. Hence it was natural that at the outset of the breeding season the male Red-crowned Woodpecker's dormitory should be chosen to hold the eggs and young; and of course he continued to sleep in it, incubating or brooding through the night. I was not certain which bird made the hole in which the Golden-olive Woodpeckers nested. Did they themselves carve it out and the Hairy Woodpecker take possession of it for a while, to be evicted later by the rightful owners? The size of the doorway suggested that it was the work of the bigger Golden-olive Woodpeckers.

By day, male and female Golden-olive Woodpeckers sat alternately upon the eggs. Despite the lowness of the nest-cavity, both were extremely confiding, and did not fly out when I stood directly below their doorway, even after I had made a noise which caused them to look forth. When I came with a man and a boy to hold the ladder while I climbed up to look in, we found the male woodpecker in charge of the nest. After I drew his attention by tapping on the trunk, he gazed calmly down upon the three

of us. It was necessary to clear a space at the foot of the stub in order to set up the ladder, and for a while the bird watched me chop down the grass and weeds so close below him. But before I had finished the work of clearing, he lost courage and flew away.

The female, after she had retired at nightfall to rest in her still lower hole, was also reluctant to quit it. If I stood in front and made a noise, she would look out; but when I approached closer she shrank back into the interior. While in charge of the eggs, her conduct was most variable. Sometimes she watched me set up the ladder beneath the nest and climb up to the first step before she winged away. At other times, a slight tap on the trunk would cause her to forsake the nest. Her steadfastness seemed to depend upon how she felt at the moment. In these sparsely-peopled mountain forests, most of the birds were more confiding in my presence than I have ever found them elsewhere; and I rarely had to conceal myself in a blind while studying a nest.

After incubation had been in progress about ten days, I devoted a day to learning how the woodpecker pair divided the duty of keeping the eggs warm. Seated on a distant stump on the hillside without concealment, I began my vigil as it grew light at 5:30 on April 15. There was no sign of activity about the nest until 7:15, when the female woodpecker suddenly flew up to the top of the stub, uttering a single, low, wiry note. The male, who had not previously showed himself in the doorway, now looked forth for the first time, then silently flew off. The female at once entered the nest. Four hours slipped slowly by without my having a glimpse of the female in the nest or of her mate on the outside. Beginning at last to suspect that the male might have replaced her on the eggs, during a moment when my attention wandered, I clapped my hands and called to bring to the doorway whichever woodpecker was in the nest. When these sounds failed to obtain a response, I advanced and tapped lightly on the trunk. Instead of merely looking out, as she usually did in similar circumstances, the female came forth and flew away. But after only six minutes she returned to the nest, and sat for another hour. Through much of her long morning session of nearly five hours' duration, she amused herself by hammering lightly on the inner wall of the chamber.

At 12:12 p.m. the male returned and clung beside the doorway. The female flew out and he entered at once. At 1:34 she returned, alighting beside the entrance with the low, wiry note I had heard early in the morning. The male silently departed and she entered. I was now obliged to be absent for a little over an hour while I visited some other nests. The female was still within when I returned at 2:42 and she sat until her mate replaced her at 3:05. I believe that she had been in charge of the nest continuously

since 1:34; for had the male taken a turn on the eggs in the interval, the period between 1:34 and 3:05 must have been occupied by three shifts—two by the female and one by the male—which would make these sessions far shorter than any taken while I was present. At 4:50 the female again returned to the stub and voiced the same low, wiry notes as before. She waited two or three minutes before the doorway for her mate to come out, but he did not even show his head. Then she went in, but emerged again at once and flew away. After her departure the male looked out, then promptly settled back upon the eggs. At 5:03 the female returned, sounded the wiry note, then entered while her mate was still inside. He at once made his exit and flew off. At 5:54 he returned, clung beside the doorway and uttered a low note; whereupon the female came forth and departed. Then he entered to pass the night on the eggs.

The female woodpecker's long morning session of nearly five hours surprised me greatly. Her two afternoon sessions lasted 91 and 51 minutes, respectively; while the two afternoon sessions of the male were 82 and 118 minutes, respectively. Considering the woodpeckers' day to extend from 5:45 in the morning to 6:15 in the evening, a period of 12.5 hours, the female occupied the nest for a total of 439 minutes, the male for 311 minutes of the day. Had her mate yielded up the nest to her when she arrived at 4:50 p.m. to relieve him, she might have had a still larger share of the day to her credit. At no other woodpeckers' nest which I have watched continuously has the female been in charge for such a large part of the day.

When one of the pair of woodpeckers came to relieve the mate in the nest, it usually waited beside the entrance for the other to leave, before it went in. This appears to be the rule with woodpeckers that sleep singly. Only at the end of the day, when the male was slow in leaving, did the female, on two occasions, enter the nest while he was still within. The first time, she came out again immediately; the second time, her mate left as soon as she went in. They did not linger together in the nest when one relieved the other, as woodpeckers which sleep together often do.

The Nestlings

Three of the eggs hatched on April 16, the fourth on the following day. The newly-hatched nestlings were pink-skinned, completely glabrous—as the botanists would say—and blind, as is usual with woodpecker nestlings. Their parents were negligent about removing the empty shells, allowing parts of them to remain in the nest for at least five days after the nestlings had emerged. Two of the young woodpeckers vanished a few days after hatching, evidently having lost out in the competition with their nest-mates for food. This is a common occurrence among woodpeckers, and appears

to result from the parents' inability to see their little ones well at the bottom of the deep cavity and to distribute the food equably among them. Eight days after they hatched, the two survivors, which had grown with wonderful rapidity, were sprouting their pin-feathers.

After the nestlings hatched, the parent woodpeckers became more wary than they had been during the course of incubation, and they would fly from the hole with far slighter provocation. I tried to watch the nest from a blind set close in front of the doorway; but the female delayed so long in approaching that I finally decided that it would be better to remove the offending brown tent and look on without concealment from a more distant point, as I had done while studying the mode of incubation. On April 27, after the cessation of the rain which at dawn a cold wind was driving over the mountain, I took my station on the hillside and watched the parent woodpeckers attend their two eleven-day-old nestlings. In the four hours and 40 minutes from 6:50 to 11:30 a.m. the male visited the nest only thrice, the female twice. Presumably they fed the nestlings on each visit, which would make the rate of feeding little better than once per hour for the two of them combined. Once I could discern a small particle of food projecting from one side of the female's bill as she entered the nest, but otherwise the parents came with no visible food. The feeding of the nestlings was evidently by regurgitation; but since this was done within the cavity, I could not watch the process. The female still made her first morning appearance at the nest at about a quarter past seven, as she had done during the course of incubation; and the nestlings received their breakfast late. They were now brooded very little during the day; for their mother remained in the nest for periods of 10 and 9 minutes only, while the father stayed for 7, 7 and then 8 minutes. And the parents did not warm the nestlings even for the whole of these brief periods in the cavity, but spent part of the time looking through the doorway. They attended to the sanitation of the nest, from time to time carrying away droppings.

Another nestling died after its feathers had begun to sprout, leaving only one alive out of the four that had hatched. At the age of 21 days the lone survivor began to appear in the doorway to receive food. She was well feathered, quite resembled her mother, and was without much doubt a young female, since juvenile woodpeckers, if they do not bear the markings of the parent of the same sex, are more likely to wear the colors of the adult male than of the adult female. On May 10, when the young woodpecker was 24 days of age, I devoted five hours of the morning to watching the parents attend her. I began my vigil at dawn, and as the light increased I could distinguish the father's head in the top of the cavity. He still passed

the night with the nestling, but perhaps clinging to the side of the chamber above her rather than actually brooding. At 5:58, immediately after he flew out, the nestling's head appeared in the doorway. She continued to watch and wait for her breakfast for nearly two hours more, for it was 7:45 before the male returned with her first meal of the day. He brought nothing that I could see in his bill; but upon arriving he clung to the outside of the trunk beside the doorway, placed his bill in his daughter's mouth, and proceeded to regurgitate food to her. The feeding was completed in two installments, each lasting a few seconds; then he flew away. Three-quarters of an hour later he came again with a second and apparently more copious meal. The youngster, still looking through the doorway, leaned far out to receive it. Clinging to the trunk beside the entrance, the father placed his bill in her mouth, but only momentarily, and apparently passed no food. Then, after a pause of a few seconds, he again inserted his bill into her mouth, and this time seemed to give her nourishment. He removed his bill, but after a pause inserted it again and delivered more food. Then twice he placed his bill momentarily into the nestling's mouth, but apparently without giving her anything. Next followed two more-liberal feedings, after which he flew away. As he went off, the youngster looked through the doorway and uttered a low trill.

The female first appeared that morning at 8:55. Clinging in a neighboring tree, she uttered the sharp, staccato *beee*, then the rapid trilled call. Thence she proceeded to the entrance, with nothing visible in her bill, and fed the nestling by regurgitation in a number of brief installments. After this she flew off and did not return during the next hour and a half. At 9:05 the male appeared for the third time. From a neighboring tree he called and trilled, and was answered by the nestling with a much weaker trill. She stuck out her long, slender, white tongue, as though in anticipation of the good things she was about to receive. But this time the feeding was short. After her father had gone, the young bird amused herself by scratching and pecking the inner wall of the nest-cavity. Through the doorway, I could see that she hung backward in the top of the nest to preen her breast feathers. In 20 minutes the male was back again and fed her more liberally, in four courses.

Thus during the first four and a half hours of the woodpeckers' active day the single nestling was fed only five times, four times by the male and once by the female. When woodpeckers nourish their nestlings by regurgitation, they bring food at a very slow rate. Two feathered nestlings of the Lineated Woodpecker (*Dryocopos lineatus*) were fed upon regurgitated food only nine times in as many hours. The rate of food-bringing for the brood as a whole was about the same as at the nest of the Golden-olive Woodpecker

on the morning I watched; but since the Lineated Woodpeckers had two young instead of one, the rate per nestling was only half as great, or 0.5 times per hour. On the other hand, woodpeckers which bring particles held visibly in their bills make far more frequent visits to the nest. The Golden-naped Woodpecker (*Tripsurus chrysauchen*) and the Red-crowned Woodpecker feed their young without regurgitation; and I have known the former to bring food at the rate of 6.7 times per nestling per hour, the latter at the rate of 9 times per nestling per hour, over brief periods. But these woodpeckers seem to give their brood much less at each meal than those that feed by regurgitation. And since they take a morsel to the nest as soon as they find it, without waiting to fill their crops, they do not make their family wait so long for breakfast as was the custom of the Golden-olive Woodpeckers.

Now that they could feed their nestling through the doorway, the parent Golden-olive Woodpeckers no longer took the trouble to go inside and remove the droppings. As a result of this neglect, the bottom of the chamber was soon covered with an accumulation of filth. This was probably no serious inconvenience to the young woodpecker, which now no doubt passed day and night clinging to the inner wall of the deep cavity, rather than resting on the bottom, as when she was younger. Other hole-nesting birds which are careful of the sanitation of the nest while the nestlings are callow and helpless cease to remove the droppings after they are no longer obliged to enter in order to deliver food; this is true, for example, of woodpeckers of the genera *Centurus* and *Dendrocopos*, of Allied Woodhewers (*Lepidocolaptes affinis*), and of the Quetzal (*Pharomachrus mocino*). None of these birds leads the young back to sleep in the nest after they have taken wing. But the Golden-naped Woodpecker and the Olivaceous Piculet (*Picumnus olivaceus*), which use the nest-cavity as a family dormitory long after the fledglings have begun to fly about, never relax their attention to its cleanliness.

In the afternoon of May 10, I looked into the nest to check upon the number of young it now contained. As we set up the ladder below her, the young woodpecker looked down at us through the doorway, then watched me climb up to her, and even permitted me to touch her bill, before she retreated into the bottom of the cavity. I had thoughtlessly placed the mirror for looking into the hole in one of the pockets of my shirt, instead of in a trousers pocket, where it should have been. As I was ascending to the topmost step of the ladder, balancing myself in a difficult position, this mirror rubbed against the stub and produced a grating noise, which frightened the woodpecker more than my approach. Suddenly darting from the nest, she turned down the slope toward the woods in the ravine. Her

flight was slow and labored; but without a rest she covered about 25 yards, in a course which at first was inclined downward, but toward the end veered slightly upward; and she came to rest in a tangle of vines that covered over a small tree within the edge of the woodland. Since other woodpeckers of about the same size (such as Golden-naped Woodpeckers and species of *Centurus*) linger in the nest a full month, I was surprised that this young Golden-olive Woodpecker could fly so well when frightened from the nest at the age of only 24 days. I had felt sure that when I looked in she would crouch in the bottom of the cavity and not attempt to fly out, and doubtless she would have done so but for the unfortunate scratching of my mirror against the trunk.

The young woodpecker was completely feathered and very pretty in her fresh, new plumage, colored like that of her mother. Soon after her premature departure from the nest, I began to keep watch to learn whether her parents would try to bring her back to its shelter; for the sun was already sinking low. The mother did not again appear in the vicinity, but at about 6:30 the father returned to the nest. Clinging before the doorway, he peered inside and all around him, as was his custom before entering, but he showed little concern over the absence of the nestling. He uttered not a syllable to call her back, as Golden-naped Woodpecker parents would have done, but silently retired into the shelter of the nest, while his daughter of tender age remained in the open, exposed to the rain.

Four days later, I found a young female Golden-olive Woodpecker, attended by her parents, high up in a moss-burdened tree at the forest's edge. Although she was about 1000 feet from the nest that I had watched, I believe that she was the fledgling who had been raised in it; for Golden-olive Woodpeckers were not abundant in the region, and each pair wandered over a wide area. I was happy to see that she was alive and well, and had suffered no ill consequences from her premature departure from the nest in the rainy weather then prevailing. Probably the great amount of rain and mist during the nesting season at Vara Blanca in 1938 contributed to the deaths of the other three nestlings from inadequate nourishment; and, since on these storm-swept mountain slopes such weather was not unusual, this might explain why the Golden-olive Woodpecker was not more abundant in the region.

For a number of nights after the departure of the nestling, her father continued to use the nest-cavity as a dormitory; but I never again saw the young woodpecker in its vicinity. In the use of the old nest for sleeping by the male parent, while the young remain in the open, the Golden-olive Woodpecker agrees with the Red-crowned Woodpecker, the Lineated Woodpecker, and the Hairy Woodpecker (see Skutch, 1955. *Wilson Bull.* 67:30).

Doubtless, as with these other species of which adults always sleep singly, the young Golden-olive Woodpecker roosted clinging to a trunk in the open, until she succeeded by her own unaided efforts in finding an unoccupied cavity suitable for a lodging.

An Ecuadorian Nest

The only other nest of the Golden-olive Woodpecker which I have seen was situated in a dead, branchless trunk, standing in the midst of a swampy area covered with bushes and low trees, in the well-wooded valley of the Río Pastaza below Baños, Ecuador, at an altitude of 4200 feet above sea level. On October 18, 1939, this inaccessible hole contained, as far as I could discover, a single well-feathered male nestling, which spent most of the time looking through his doorway. During an hour and a half each of the parents fed him twice, by regurgitation; and it is perhaps significant that the male returned in slightly less time than the female. Although they delivered food while clinging below the doorway, at the conclusion of a feeding they pushed past the nestling to enter the cavity and clean it. The fact that the head markings of this nestling resembled those of the adult male, while those of my Costa Rican nestling were like those of the adult female, shows that in this species young in their first plumage wear the colors of adults of the same sex.

Summary

In Guatemala, Golden-olive Woodpeckers were found in pairs in October, among the shade trees of the coffee plantations.

At an altitude of 5500 feet in the Costa Rican highlands, the roosting and breeding behavior of one pair were followed through most of a year. From August until the following April, a female lodged alone in various low cavities in stubs in a pasture surrounded by heavy forest. She occupied one dormitory for at least two months. After sleeping for some weeks in an old hole in a stub, she moved to a freshly carved hole higher in the same trunk, which had been used as a lodging by a Hairy Woodpecker.

The high-pitched, clear, powerful, long-continued roll or trill of the male was heard from mid-February onward.

At the beginning of April, four eggs were found in the cavity where the Hairy Woodpecker and then the female Golden-olive Woodpecker had slept. Now the male Golden-olive Woodpecker occupied this hole by night, while by day he took turns with his mate in warming the eggs. In the course of a day, the female incubated for three sessions lasting 297, 91, and 51 minutes, the male for two exclusively diurnal sessions of 82 and 118 minutes. Allowing 12.5 hours for the woodpeckers' active day, the female was in

charge of the nest a total of 439 minutes, the male for 311 minutes (which includes extensions within the active period of his long nocturnal sessions).

Although four nestlings hatched, only one was raised, the others apparently succumbing from malnutrition in inclement weather. Both parents fed by regurgitation at a very slow rate. With two 11-day-old nestlings, they brought food only 5 times in 4 hours 40 minutes. With a single 24-day-old nestling, they brought food 5 times in 4.5 hours. The male was the more active provider.

The parents at first kept the nest clean, but neglected sanitation after the young took food through the doorway and they were no longer obliged to enter for feeding.

The young woodpecker, completely naked at hatching, was well feathered at the age of 21 days and resembled her mother. Frightened from the nest when 24 days old, she flew with slow but sustained flight.

After her departure, the fledgling did not return to sleep in the nest, which the male parent continued to use as a lodging.

An Ecuadorian nest contained, in October, a feathered nestling which resembled the adult male, showing that in this species young in their first plumage resemble adults of the same sex.

El Quizarrá, San Isidro del General, Costa Rica, August 7, 1955

A BEHAVIOR STUDY OF THE RED-WINGED BLACKBIRD[1]

II. Territoriality

BY ROBERT W. NERO

THE first portion of this study (Nero, 1956) dealt with the behavior of the "Redwing" (*Agelaius phoeniceus*), particularly as related to mating and nesting activities. The present paper describes the formation, maintenance, size and structure of the male territory; female territorial behavior; and behavior of first-year (one-year-old) males, as observed in the vicinity of Madison, Wisconsin.

Territorial Behavior of Adult Males

Male intolerance.—The territory of the male Redwing is a clearly circumscribed portion of the breeding grounds from which he repels Redwing males, females other than his mates and, at times, even fledgling Redwings. Territorial boundaries are well-defined and fixed throughout a season, the boundaries often being maintained within a few feet or less (Nero and Emlen, 1951). Resident males responded to strange males by first giving song-spread, then bill-tilting, and then flying to attack (but usually displacing the intruder without actual contact). (For description of bill-tilting and song-spread see Nero, 1956:9–12.) These three responses probably represent increasingly greater threat displays. The direct, fast flight toward an opponent also seemed to have an intimidatory effect. Further aggression was shown by a sudden "crash-landing" with which males often displaced intruders. This was often accompanied by the threatening "growl-call" (Nero, 1956:22) and an antagonistic open-beak display.

A resident male's aggressive intolerance extends to a wide variety of birds on or near his territory. Between 1948 and 1951 I recorded incidents wherein 20 species (of 13 families) were threatened or attacked; often the individuals were merely chased. Redwing males were persistently aggressive toward Bronzed Grackles (*Quiscalus quiscula*) and Long-billed Marsh Wrens (*Telmatodytes palustris*), which were nesting on the marsh, but they seemed only temporarily interested in evicting other species. In spite of the impressive array of evicted species, three male Cardinals (*Richmondena cardinalis*) were once observed singing on the marsh unmolested. The nesting male's aggression toward the human species is well known, but deliberate encounters with Sparrow Hawks (*Falco sparverius*) are probably rare. On two occasions I watched Redwing males triumph in fights in mid-air (beak to beak) with this species. Hawks of other species elicited a different reaction. Redwing

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alarm whistles (high and shrill) passed from marsh to marsh when hawks were first sighted. Nearly all Redwings on the marsh sat quietly on their perches with concealed epaulets when hawks were soaring overhead or when they were perched nearby. It seemed that different species drew different responses, but this was not clearly documented. Redwings responded to accipitrine hawks, which were actually hunting on or near the marsh, by suddenly diving down into the cattails to hide or by flying in a group high above them. The admirable boldness of the male was sometimes exhibited by his mate, particularly in conflicts with the Marsh Wrens and Bronzed Grackles. On one occasion when a sheep approached an upland Redwing nest the female owner attacked first, landing on the sheep's forehead; she was later joined by the male which landed on the rather unperturbed sheep's nose. Under this onslaught the mammal withdrew. The largest and heaviest "opponent" which I ever saw evicted from a territory was a large plow-horse which had come to the edge of a lake to drink. A male Redwing clung to the horse's rump and pecked determinedly as he plunged toward higher ground. Neverthless, the tiny Warbling Vireo (*Vireo gilvus*) has often driven my Redwing males from the vicinity of its nest in the trees bordering the marsh. Determination and "moral right" often decide the "victor," but so does opportunity: Redwings frequently chased other species after the latter had taken flight!

Size and Shape of the Male Territory.—Individual territories were roughly square, rectangular, circular, or highly irregular. Some variability was presumably due to response to the pattern of the marsh vegetation. It seems probable that the presence of a high song-perch also had some influence on territory shape. Nearly every territory included a tree and in several instances birds which were located centrally on the marsh had territories with long extensions out to the trees along the edge. Mayr (1941:78) found a similar situation in New Jersey. I found that whenever a tree branch was artificially set up in the cattails in a territory it was quickly utilized as a perch by the resident male. Territory size appeared to be strongly affected by the pressure of other males. New residents, especially those which moved into a well-populated area, often had very small territories. These might be suddenly increased through disappearance of an adjacent male, or gradually, as a result of persistent aggression.

The average size of 17 territories of well-established males during incubation and fledgling stages of breeding was 3,550 square feet (roughly corresponding to a 60-foot square or approximately one-twelfth of an acre). The minimum size was 1,330 square feet (about 1/32 acre), the maximum size, 6,280 square feet (about 1/7 acre). Linford (1935) found much larger territories in Utah: average, 31,603 sq. ft.; minimum, 17,292 sq. ft.;

maximum, 45,903 sq. ft. Twelve territories of the Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*) measured by Fautin (1940:78) averaged 1,294 sq. ft. (range, 760 to 2,275).

Territory size generally varied inversely with population density. In 1947, 14 males shared the eastern one-third of the marsh (Beer and Tibbitts, 1950: 75); in 1953 the same area was divided among only seven males, nearly all parts being completely utilized and defended. The territory of one persistently-returning male showed a constant increase in size from 1949 to 1953 (1,326 sq. ft., 3,125, 4,400, 4,450, 5,350). Similar data for other individuals were not obtained. Although territory size increased, the number of females per male remained about the same, the female population having decreased during this period. In 1947 Beer and Tibbitts (*loc. cit.*) found 91 nests with eggs in the marsh. From 1950 to 1952 I found, respectively, 50, 38, and 35 nests with eggs. In 1953 two cooperating students, Messrs. Roy Gromme and Norbert DeByle, found only 27 nests. These figures are probably complete in all cases, as the coverage was thorough.

Incipient Territorial Behavior in Transients.—From March 20 through 28, 1952, I observed many adult males (unmarked) apparently occupying definite areas in the tops of the high trees across the road on the south side of the marsh. These birds behaved in many respects like typical territorial birds, showing complete song-spread and fighting. This behavior was possibly associated with the heavy migration which occurred at this time (in 1952 the marked residents arrived between March 17 and March 30), and suggests the appearance of the territorial urge in migrants.

These "temporary residents" often flew considerable distances to drive off other males and then returned to their original positions. Often two or more of them perched close together without showing any intolerance, but they gave song-spread to newcomers and also drove the latter birds away. Some of the temporary residents flew away after a short time, but others remained for several hours. Some of them showed an interest in the marsh as well as the tree-top area, but the many new males which frequented the tree tops seemed to offer more attraction. The temporary residents gave some displays which are usually given to females and in some cases appeared to contest with their associates for the right to display or to chase newcomers. For example, on March 26, when a new male approached the tree-tops without song and with his epaulets covered, one of the temporary residents gave song and displayed to him, and at once another temporary resident flew to them and chased the displaying bird. The new arrival meanwhile flew after the chaser and seized his tail momentarily while in flight. Perhaps aggression was aroused by the sight of display, so that while associates at rest ignored each other the display by one to a new bird provoked an attack. Similar

behavior was not observed on the marsh, owing perhaps to the stable conditions of the territorial system.

A few birds appeared to be more persistent and later showed an interest in the nearby marsh by at times swooping down over it with song, although returning to their tree positions. Some of these may have been true residents, but lack of marking made this impossible to ascertain. Some resident males on the marsh, particularly those with territories adjacent to the trees, also tended to utilize the tree-tops, apparently in response to the temporary residents and migrants.

Reestablishment of Territories by Returning Residents

Beer and Tibbitts (1950) have shown that there is a strong tendency for former residents to return each year to the same breeding grounds and also to hold the same general area as a territory. On the first day of their arrival former residents usually appear wary and are easily flushed, but in a short time, even by the second day, they become less wary. At this time it is sometimes possible to determine their territorial inclinations by simply forcing them to move several times, their movements often being within a limited area (often corresponding to their territory of the previous year). In the early spring they may be found on their territories in the early morning and late afternoon, giving song-spread, particularly from one or two special song-perches, within or on the edge of their territory, and constantly flying out onto the cattails to sing or to confront neighbors (Fig. 1).

Some early arrivals show a tendency to occupy a territory larger than that which they had held in the previous year, retracting as other birds move in and take up territories. Residents which had previously held small territories usually attempted to enlarge their holdings and often succeeded. Most birds, however, remain within the approximate boundaries of former territories. Former residents generally seem more casual about territory establishment than do new birds; that is, they appear to be more tolerant of trespassers.

Respect for boundaries is apparent even in the temporary absence of the owner, although trespass is then more frequent. Residents occasionally trespassed for short times on other territories in order to drive off strange adults or first-year males, to engage in sexual chases with females, and to harass predators. When a female which has been on a territory with a male flies to another territory, the first male may dash across the border to strike the female and then hastily return, sometimes even before the neighbor has a chance to drive him back. On at least one occasion when this happened, the female flew back to the original male's territory. These conditions

provided one of the few occasions upon which males persistently crossed territory boundaries. Similar reactions were elicited when a female dummy was moved from one territory to another, the trespassing "husband" continually returning to the dummy even though severely attacked by the second male. A trespassing male usually shows signs of recognition of the territorial rights of neighbors. This was clearly seen in the above experiments. Each time the "claiming" male invaded a neighbor's territory to "visit" the dummy, his epaulets were concealed and he never gave song-spread, but each time he returned to his own territory he immediately gave song-spread with fully-exposed epaulets. Similar behavior was observed when a male trespassed in order to feed on a piece of bread placed a few feet beyond his boundary.

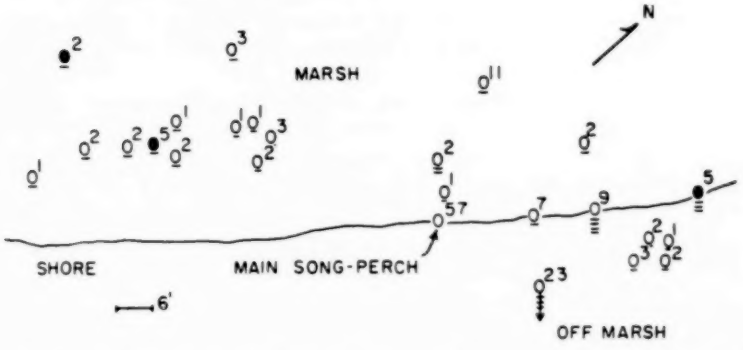

FIG. 1. Activities of one adult male, 7:00 a.m. to 9:30 a.m., March 30, 1948, showing time spent on the main song-perch and excursions into the territory. Circles indicate areas visited by the male; lines beneath the circles, number of visits; figures, total number of minutes at the site; dots, encounters with other males. Most, but not all, visits were made directly from the song-perch.

In cases where adjacent males returned a second year, territory lines often closely followed those of the previous year. Males whose territories do not adjoin may not have developed the tolerance or mutual respect, possibly developed in the previous year, which characterizes settled neighbors. For example, on April 5, 1953, it was first noticed that a resident male had disappeared and that his neighbor to the north had moved onto his territory and was being attacked furiously by the neighboring male to the south with which he had previously had no contact.

Nevertheless, well-established males continue to meet on their boundaries throughout the breeding season. There seemed to be a tendency for adjacent males to face each other at rather definite places along the border of their

territories, especially where shrubs or trees provided higher perches. Ordinarily these contacts are confined to mutual bill-tilting, but occasionally quite severe fights occur. Meetings of this sort arise primarily from movements or behavior of the resident females which bring about sexual responses in neighboring males. A male seldom interferes when his wandering mate is aggressively repulsed by the neighboring male, but when the latter approaches the border with obvious sexual response he is immediately met by the "guarding" owner.

Establishment of Territories by New Birds

1. *Territorial establishment on unoccupied areas (early in season).*—In general, a male selects a location to which he constantly returns and in which he remains for long periods of time. Song-spread is given frequently from definite perches within or on the edge of the territory and also from other points within the area. Territory settlement in the very early part of the breeding season often occurs without any fighting or interactions simply because of the low number of competing males. However, as more males appear vigorous battles may ensue and complicated situations may develop. Some illustrative cases follow.

2. *Intrusion between and adjacent to occupied territories.*—Males may intrude or insert themselves on established territories through a gradual process of persistence often involving a sequence of behavior which I have called "challenging."

A new arrival persistently flies toward a male on territory as if inviting chase and when this occurs retreats or dodges ("testing the male"). He flies low over the territory with slowly-moving down-held wings, alternately gliding and flapping ("testing the territory"). Sometimes as he glides over the territory he suddenly looks back over his shoulder toward the resident ("head toss";=bill-tilting?). When the resident flies toward him the intruder retreats, or dodges and circles about the territory, now fast, now slow—sometimes gliding, as the resident moves. In this fashion the intruder leads the resident, which keeps above him, higher and higher, ever circling, sometimes until they are hundreds of feet in the air and sometimes far from the territory ("soaring flight"). Often during the flight the intruder swoops and pecks at the resident, and vice versa. The resident attempts to keep above the other, alternately gliding and flying "in step" with him, until one or the other breaks off. Then the intruder either flies elsewhere or back to the territory, and the flight begins again.

New males may challenge or make sorties at several males on the territorial grounds, as if attempting to find a suitable opponent. For example, on March 26, 1952, at 5:30 p.m., a new male was seen challenging several

residents, one after the other, all surrounding a central area on which the new bird was focusing its attention. Soaring with the first male lasted well over four minutes and took the two up in the air about 200 feet. The newcomer persistently returned to the center of the marsh and glided over the cattails with head up, thus invoking immediate chase by the nearest male, which he would then lead up in soaring flight. He did not land on the cattails, but glided over them and then headed for an individual. Although as many as three birds chased him at one time, only one of the three followed him up into the air.

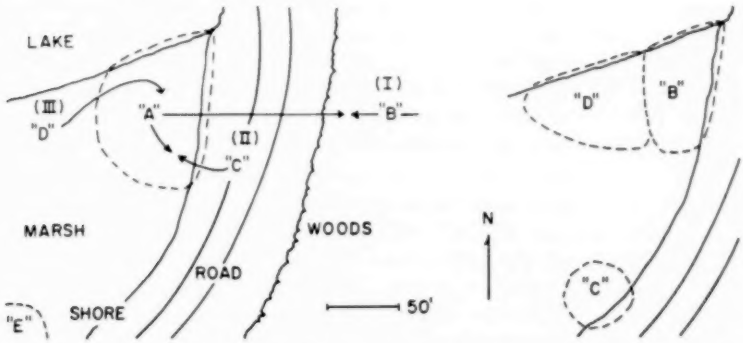

FIG. 2. Spatial relations of 5 males, March 20 to April 24, 1952. (Left map) (I). Male A held male B far back in woods from March 20 to April 21. (II). On March 30 male C arrived and challenged male A. (III). Male D quietly took over a portion of the territory during the period when male A was fighting male C. Male A was trapped on April 21 and disappeared following his release; D and B shared the area subsequently (right map). Male C, beaten by male A, finally established a territory farther south (April 24).

In other instances a new male "selected" a particular male to challenge. From March 20 to April 21, 1952, the owner of a territory, A, forced a challenging male, B, to remain at bay, some 400 to 500 feet back in the woods away from the territory (Fig. 2). Whenever male B made the least approach toward the marsh, the resident immediately flew toward him and repulsed him. The bird thus held back in the woods (male B), repulsed all other males from his vicinity just as if he were on territory, even though the area he occupied was unsuitable as a nesting area. When male A became concerned, eight days later, in chasing and fighting with a second, more aggressive rival, C, male B moved up to the edge of the territory. Each time when the owner returned, however, he quickly withdrew. The situation remained as above up to April 21, with male B pushed even farther back

into the woods away from A's territory. On April 21, male A entered a trap, and male B moved in and occupied a portion of his territory opposite another rival, D. The latter male had easily intruded during the period that A was concerned with male C which was driven away. The trapped owner was released but disappeared (his remains were later found in the marsh, possibly killed by a mink) and B held his portion of the territory through the remainder of the breeding season.

Male C had performed beautifully as a challenging male, engaging in all the stages of the pattern, gliding over the territory, swooping at male A, tossing his head, and leading male A in soaring flight. Male A became so concerned with driving C from the area that he "permitted" male B to venture to the edge of his territory, and he seemed to overlook completely the presence of D, which very easily slipped in and gave extreme song-spread display right next to the panting owner (A). However, male D, in contrast to all the other males, had occupied this area in 1951.

Male C was badly beaten and did not return to this disputed territory. However, a few days later (April 3) he was found engaged in a contest with another resident male, E, three territories to the south. A summary of the field notes of this latter contest follows:

5:00 p.m. When first observed, male C was on "territory" far back in the woods (south of the territory held by male E) and was apparently held there by male E, which sang from the cattails to another resident at times but spent the majority of his time on the trees across the road, apparently watching male C.

5:10 After 10 minutes C began flying toward E, making short flights directly at him, but always swerving aside at the last moment. E usually at once darted at him and each time male C returned to his distant perch.

5:20 After 10 more minutes he began flying toward E and then swerving past him toward the territory; but he always retreated whenever E moved toward him. But C appeared to have gained some ground, he was closer to the edge of the woods, and he seemed more confident. A short while later C began striking at E, but always dodging and withdrawing before E's attacks, and then leading E up into the air in soaring flight. They circled higher and higher, making short darts at each other and then came down again, and C returned to his distant perch, probably to rest.

5:35 Fifteen minutes later E sailed down to his cattails and C at once flew straight in to join him, sailing over the cattails in a similar fashion. But at the first sign of attack by E, male C retreated. E then showed his ownership, almost seemed to flaunt it, by parachuting onto the territory with song-spread display, and as soon as he did this C flew right in to him and, as he passed by, E pecked at him and drove him back.

5:40 This again led to the soaring flight. No matter how high they flew E always kept above C and often tried to peck him. But C maneuvered from side to side and nicely eluded his attacks.

5:45 Male C sailed first over the territory and of course E at once drove him off. C constantly provoked a fight, but always retreated.

Finally C sailed into the territory, hovered over the cattails with raised head and then returned to the woods. Again and again he did this, never landing, while male E watched closely but did not chase. Then E soared down to his territory and landed while C cruised over him and then retreated to the woods.

5:55 E chased C numerous times as the latter flew past him. Male C kept coming closer, but he was always on the dodge. He "tested" the territory by hovering over it, but he did not land, nor did he stay to fight. He did this again and again, ever more frequently, and finally he *went down low* over the cattails when E chased him. He went through this behavior dozens of times more and, as he sailed and hovered over the territory with raised head, looking back over his shoulder, there was no mistaking his challenge.

6:30 At 6:30 male C succeeded in *landing* on the edge of the territory, if only for short moments, and then he finally *remained* there facing male E with song-spread.

The next day (April 4) at 8:30 a.m., C was still back in the woods, but he flew straight and low to his "beach-head" on the edge of the territory (on the border of E territory and another) where he sat low and under cover and singing. Male E, meanwhile, sat high above him, also singing.

Observations were discontinued until 5:45 p.m. At this time it was found that E had entered a trap and C was now uncontested owner of the territory —and he plainly showed it. The situation was left thus (April 4, 1952). (However, on April 23, 1952, male C was dominated by a new male and forced off his territory to an adjacent position—see 3b, below.)

(On April 22, 1955, I observed a challenging male flying over a territory and being driven alternately by three residents. The challenger never sang once during 1½ hours of observation although the three residents sang with extreme display. When I placed a mounted male in the "wanted" territory the resident bird paid no apparent attention, but the challenging male dived down at the dummy several times when crossing over the territory. It seemed as though the challenging male "resented" the dummy more than did the resident.)

3. *Displacement of established residents.*—Sometimes males intrude on established territories in the presence of the owners by simply appearing on the area and persisting in the face of attacks by the residents. Occasionally, however, they show immediate dominance over the resident. Three cases illustrating this phenomenon under various conditions are recounted below.

a. *An old resident is dominated.*—A remarkable case of an intrusion occurred in May, 1953, when a male which had been a resident since 1948 was completely dominated and forced off his territory by an unmarked adult male. This case was first noticed on the morning of May 5, when the resident male, which had arrived on March 21, was seen resting on the edge of his territory while the new male sang from the resident's favored perch. Throughout the period of observation the intruder drove the owner with

fierce attack whenever the latter attempted to move into the territory. The resident was seen returning to the area in the late afternoon, but he was immediately driven across two territories by the new male. The resident was not in sight the morning of the next day, but at 5:30 p.m. he was found on his territory, giving extreme song-spread near a trap which held an unbanded male, presumably the intruder. The trapped male was removed from the marsh and the resident held the area for that season and the next as well.

b. *A new resident is dominated.*—In another case, shortly after the arrival of a female on a territory, and probably before the pairing bond was fixed between the male and the female, a second male appeared and rather quickly dominated the resident, forcing him off of his territory onto adjacent holdings. Neither bird had held the area in the previous year. This case is described in detail below:

Male C (second-year adult) held a new territory from April 4 to April 21, 1952. No observations were made on April 22. In the afternoon of the following day a marked female and an unbanded adult male (distinguished by a broken feather in one wing) were present on his territory. The resident bird was also present and was clearly being dominated by the new bird. The full story follows:

5:00 p.m. Male C is being threatened by an intruder which actually attacks him on his own territory! He follows the resident about, crouches above him, flies above him as he flies, drives him constantly—in short, completely dominates him, so that the resident is forced to sing while in flight over his own territory much like an intruder. The new male attacks him constantly, wherever he goes. There is a battle in the cattails, and then another; the resident always losing. The resident drives at the female, then flies at the new male which at once drives him lower down into the cattails.

5:15 p.m. The old resident makes another pass at the new bird which now seems more excited and gives an even fuller display. There is a great deal of bill-tilting between them, especially by the resident when the new bird approaches him. They both tilt and walk up on the song-perch. It is clear that the resident does not display as much as the new bird. The owner displays most when in flight gliding over his territory. The new male often gets above him and displays down to him.

5:30 p.m. The action continues as above with the new male constantly driving the old resident which has moved farther east onto the next territory (whose owner remains aloof) from which area he makes futile attempts to return to his territory. Finally they engage in a furious fight which takes them up into the air; again and again they engage in aerial combat.

April 24, 4:00 p.m. The old resident and the new bird are apparently still engaged in the duel, but to a lesser extent, for the resident seems to have moved to the east of his territory, the male in that area having withdrawn for him.

5:15 p.m. The old resident now sings from a new perch 70 feet to the east. He remains there for 20 minutes even though the new bird which now holds his territory is temporarily absent.

He subsequently held a territory in the new area and the male which evicted him held the original territory.

c. *A male loses a portion of his territory including a female and her nest.*—In this case a newly-arrived male seized a portion of a resident's territory in which a female had already built a nest. The female stayed with her nest and later mated with the new male for a second brood. Since this is a unique occurrence it is presented below in some detail.

Male F arrived on March 28, 1952, and quickly occupied essentially the same area he held as a territory in 1951. On April 16, female F appeared on his territory. She had been a resident in 1951 on an adjacent territory with another male. This female associated with male F for at least the next 18 days (until May 3). No observations were made on May 4 or 5, but on May 6 a newly-arrived male, G, in adult plumage for the first time (second-year male), was observed holding a portion of F's territory which included female F's completed nest. Male G was also courting a new female (G). On this day male F still showed an attachment to female F, but also a respect for the new male. On May 20 and 28 male F still showed an interest in and a tolerance of female F, but on June 3 when she was feeding fledged young he seemed antagonistic toward her.

Since it was not clear whether male and female F were entirely separated a simple experiment was performed on June 4 which showed this to be the case. Two caged young of female F's brood were placed in territory F and for half an hour male F kept female F from feeding her young. Female F later nested again but with male G. She was seen with him on the marsh on July 10.

* * *

Male Song Sparrows (*Melospiza melodia*) show a "challenging" behavior when attempting to intrude on established territories (Nice, 1937:57–58). The intruder puffs up like a ball, often holds one wing up and fluttering, and sings rather constantly and rapidly, if often incompletely. The defender sits silent and hunched in menacing attitude, following every move of the newcomer, which sings in flight from one bush he wants to claim to another. "Soon the owner begins to chase the intruder, but the latter, if determined, always returns to the spot he wants to claim." The two finally fight and either the intruder is routed or the resident retreats. In a later work Nice (1943:155) considers the "puff-sing-wave" behavior indicative of the ". . . threat of a bird at a temporary disadvantage." Even returning residents adopted a subservient attitude to new occupants of their old territories, but the old birds soon reversed their roles and regained their territories. An old Song Sparrow was never observed to be defeated. This was not, as noted, always true in the Redwing.

In the Robin Redbreast (*Erithacus rubecula*), Lack (1946:41–43) observed eight encounters in which a new male attempted to dispossess another of its territory. In six cases a kind of "challenging" behavior, a ". . . formal procedure, of alternate loud singing and chasing, was continued all over the territory." In two of these encounters ". . . the dispute ended with the newcomer leaving the territory." But in three the owner left, and the newcomer took possession. Fighting in these cases was minimal. The newcomer in one case ". . . did not attempt to strike the previous owner; it seemed just to wear it down by persistence."

The male Reed-Bunting (*Emberiza schoeniclus*), according to Howard (1929:5–6), sometimes invades established territories by persistently clinging and returning to a corner of one. He is ". . . so insistent in maintaining his position that he breaks down all opposition: and in the course of a few days his rival yields, retires to the opposite corner of his ground and there makes for himself a new headquarters."

Brown and Davies (1949:77) report the following for the Reed-Warbler (*Acrocephalus scirpaceus*): "Sometimes the encroaching male may take over the entire territory and perhaps the nest and hen of the original owner. Sometimes the encroaching male may be completely repulsed, in which case he will almost certainly try to elbow himself in on some other territory in which he may find weaker opposition. Between these two extremes there will be all gradations from the cock which manages to establish himself in a small territory, to a cock which almost but not quite swamps the territory of the bird into which he is encroaching." The same may be said for the Redwing.

Competition for Territory Sites

Response of extra males to a vacancy.—Territory-seeking males appear commonly on the breeding area throughout the season. The absence of a resident bird through death or even his enclosure in a trap immediately sets the stage for the appearance of new birds. The pressure of males and the complications which may develop under these circumstances may be shown by the following case.

On May 4, 1950, (at 1:45 p.m.) two resident males, H and I, were found in traps which had been set early in the morning in their respective territories. Two new males, H1 and I1, were in possession of their territories. Male I was held but male H was released. At once H returned to his territory and drove the new male, H1, away from his territory. Male H1 then moved over to I territory and quickly dominated the second new male, I1, forcing him to leave the marsh at 2:23 p.m. although the latter (a banded bird) continued to visit the territory.

At 2:35 the resident male I was released. He flew to his territory, bathed quietly and then left, with his territory in the possession of H1. The latter had flown down near him but had not attacked. At 4:40 a third new male, I2, appeared and quickly dominated H1. I1 then returned and remained. These three birds quarreled over the area until 6:15 p.m., when observations were discontinued. At 5:00 a.m. the following morning, male I was found in complete control of his territory and the three temporary occupants had disappeared. I arrived in time to see him drive an unmarked adult from his territory.

Responses of established males to new neighbors.—Established males usually contend more with new neighbors than they do with their old associates, but the amount of interaction varies with circumstances and individuals. Most new males are quickly integrated into the territorial system, especially if they observe the established boundaries. However, aggressive efforts to expand their holdings create active disputes. Contacts occur generally only when territories are contiguous, and former residents usually remain within their territories. Occasionally, however, former residents, subjected to persistent aggression, move beyond their boundaries to retaliate.

In one unusual case in 1950 a new male was persecuted by several residents at the same time. Although this male showed the typical behavior of a territorial male and used full displays and complete song at all times, he was driven by six different males until he eventually relinquished his claim. Although he backed off in the face of aggression he always responded with full displays. One wonders why this bird elicited constant and vigorous aggression from all the adjacent males (some even left their territories to attack him) when those birds which preceded and also followed him on the same area did not.

Behavior of First-year (one-year-old) Males

Territorial.—It is well known that male Redwings do not generally breed until their second year, by which time they have also attained the adult plumage. A few observers have noted occasional first-year males holding territories (Beer and Tibbitts, 1950:65) and even breeding (Wright and Wright, 1944:58), but there are no published observations on the behavior of first-year males on territory and their relationship with adults. Wright and Wright (*loc. cit.*), have shown that males come into active spermatogenesis in their first year, although their testes reach a maximum in May, three weeks later than those of the adults, and are not as large as in the adult. Beer and Tibbitts (*loc. cit.*) stated that first-year males ". . . do not usually have the drive to establish a territory for themselves." They observed first-year males establishing temporary territories three times. In

each instance the territory was only maintained for two to three weeks, from about the middle of April until the first week in May.

There is no record of a first-year male breeding on the study area, but in 1950 I found one about ¼ mile away in the company of a female near an empty nest. Both birds were evidently feeding fledged young, although these young were not found. The pair was seen in the same place from June 19 to June 24, (both having been trapped and color-banded). Neither bird was seen after the latter date. The neighboring, resident adult males had shown the usual recognition of male territory boundaries. On June 23 I observed several adult males driving other first-year males away from the territory of the absent, resident first-year male. An adult male circling above me in alarm quickly left when the resident first-year male appeared and took his place. In most cases the few first-year males I observed holding territory on the study area quickly retreated before adult threats, but they also appeared to be treated by the adults with a certain amount of deference (or indifference?) at times. In two cases first-year males behaved as active territorial birds for several days and then suddenly withdrew although apparently undefeated. The song-spread of these birds seemed as complete as that of the adults, although they lacked the brighter plumage. The urge to hold a territory simply seemed to wane after a few days.

The temerity of first-year males is also evident from the numerous occasions upon which they have been seen to pursue and hit adult males while in flight, even seizing them by the tail. On one occasion when this occurred the adult turned about and the two birds fought with beaks and toes while in mid-air. A moment later the chase was resumed with the first-year bird again driving or following the adult (April 30, 1950). Most encounters of this sort seemed to be with non-territorial adults. It is evident that first-year males sometimes may behave like adults and show bold and aggressive territorial inclinations. Under such conditions they appear to be treated in much the same manner as intruding adult males, except that the resident adults show a much greater tolerance toward them. First-year males only rarely succeed in breeding; ordinarily they seem to lack persistence in maintaining a territory.

Behavior of First-year Males Toward Females and Young

Throughout the breeding season first-year males often attempted to approach resident females on the breeding marsh. In nearly all instances the females gave a loud, rapid, and shrill "pee-see-hee-hee-hee . . ." sometimes accompanied by fluttering wing tips (that is, rapid opening and closing of the primaries). The resident adult males usually responded by flying up at once and driving off the first-year males. Females were never receptive

to first-year males and often escaped their advances by diving into the cattails when the latter came close. The females showed a special reaction to first-year males, often bill-tilting and sometimes giving song-spread, responses which they have seldom, if ever, been seen to give to adult males. In one case a first-year male approached a female whose mate was momentarily involved with another male and thereby drew more responses than are ordinarily seen. Each time he flew toward her the female fluttered her wing tips and screeched; finally she bill-tilted and pecked at him as he sidled close to her along a branch. Her mate returned at this time and the first-year male flew away. In another instance on the Vilas Park feeding ground (July 29, 1948) an adult female repulsed and then drove off a first-year male as he attempted to approach her. When the same female was approached by adult males she dropped one wing to the ground and moved away.

The first-year males also attempted to approach young of the year in a manner suggesting a sexual motivation. On numerous occasions at Vilas Park in June and July, 1948, first-year males were seen attempting to approach juveniles (as well as females) from the rear. The males were possibly attracted to the young by the latter's begging posture which greatly resembles the pre-copulatory posture of the female. On nearly all attempts they were repulsed, even by the youngest birds which seemed to recognize the first-year males as readily as did the females. Several times juveniles were seen to beg food from adult males and immediately afterward repulse first-year males. Even the juveniles assumed the bill-tilting posture when repulsing first-year males. In some cases first-year birds succeeded in mounting young. On July 8, 1950, a young bird begged to a first-year male three times and each time the young male mounted the juvenile and fluttered his wings overhead as if in attempted copulation. The first-year male in this case had held a kernel of corn in his beak. Somewhat similar behavior was observed on other occasions and could presumably have induced begging.

The Female "Territory"

Female Territorial Behavior.—The activities of an established female on the marsh are largely within her mate's territory, owing mainly to the aggressive responses of neighboring males. (Alien mated or paired females usually draw only antagonistic responses from resident males; see Nero and Emlen, 1951). I have only one record of an adult male "courting" an alien, mated female and this occurred under experimental conditions. A female which had eggs was placed in a cage in a distant territory for 20 minutes and then given a slow release (June 1, 1950). Instead of immediately flying away as usual, she slowly walked out, drank and fed. The territory

owner approached her at once, with fully extended wings, stopping only to drive off his chattering mate. The female paid little attention and soon left. One of the main activities of the female is the aggressive defense of an area (with song-spread, bill-tilting, and attack) against instrusion by other females. Female intolerance of other females, however, varies considerably. At first, females often attempt to defend a large portion of the male territory, but as breeding progresses their attention turns more to the nest and to a much smaller surrounding area. By the time females have eggs in the nest they usually have developed a mutual tolerance over most of the male's territory, although the nest-site is still vigorously defended. Linford (1935) seems to have been the only previous author to describe "territoriality" in the female Redwing. He noted that each female claimed an area around her nest which she defended from other females.

Usually newly-arriving females establish territories without too much opposition by resident females. In large male-territories, where there is more room for subdivision by females, quarreling may be slight; in smaller male-territories female quarreling may be more pronounced. This is presumably the situation that Linford (*op. cit.*) observed. He stated that in a large male-territory the outlines of the female ". . . sub-divisions will be rather vague; but if it was small, then they will be sharply defined." Sometimes in the early stages of female territory development, intolerance of females is so general that other females have difficulty entering a male's territory. New females occasionally forced their way into a territory by persistence, threat, and actual fighting. The male often interferes in such disputes, invariably attacking his original mate. In one case (June 12, 1950) interference by his mate, which was just beginning to build a second nest, caused a male to lose a new female which had just appeared on his territory. While he was engaged in driving his mate far from his territory, the newly-arrived female was attracted to an adjoining territory by the resident male which had courted her from along the territory boundaries. However, in another case (April 18, 1950) a female which had arrived only the previous day drove a new female off of the male's territory several times, while the male looked on without interfering. The new female persisted in returning to the territory, however, and finally located there.

Nest-moving experiments (Nero and Emlen, 1951) showed that even after a mutual tolerance was developed between intra-harem females, actual visits to the nest were repulsed. Females from neighboring male-territories were actively repulsed at first, but later a partial mutual tolerance developed.

Female Territoriality in Other Icterids

Similar territorial behavior in females has been noted in the highly-

territorial Yellow-headed Blackbird (Fautin, 1940:81–82). "The females seemed to exercise dominion over a small area immediately surrounding their nests but did not recognize the boundaries of the male's territory in which they nested. . . several females nested in the same male's territory, and although the different females in a few cases constructed their nests less than a meter apart, yet they were generally intolerant of each other in the vicinity of their own nests and more frequently occupied opposite extremities of the same male's territory. . ."

In the Brewer's Blackbird (*Euphagus cyanocephalus*), in which the male territory is loose and mainly connected with individual nest site and adjacent perches, the females "'lay claim'" to nest sites before actual construction begins (Williams, 1952:12). Aggressive activity for the possession of a nest-site ". . . is frequently prolonged and often acute and is largely carried on by females." According to Lack and Emlen (1939:226), in the highly-colonial Tricolored Redwing (*Agelaius tricolor*) ". . . the females usually ignored each other, but occasionally chased each other short distances." In Wagler's Oropendola (*Zarhynchus wagleri*) the males show no territoriality but accompany the females as the latter move about in small groups selecting their nest-sites. There is considerable quarreling among females over these sites (Chapman, 1928:138–140). Female Boat-tailed Grackles (*Cassidix mexicanus*) build in colonies apart from the males, which play no part in the nesting activities and remain in flocks (McIlhenny, 1937:278–282). No mention is made of inter-female tolerance at the nest-sites, but an island 34 feet by 32 feet was found to contain 34 nests.

Territorial Site Selection and Change of Mates

The nest-sites selected in successive years were recorded for 16 marked females. Nine of these returned for three seasons, four for four seasons, and one for five seasons. These records showed that females frequently nested in different places in successive seasons. The relocation distance of 30 nest-sites (Table 1) ranged from 4 feet to 240 feet (average, 65). These shifts caused some change of mates. On 10 occasions seven females mated with other males even though their former mates were present on the marsh. These females moved from 16 feet to 240 feet (average, 98; see Table 1). Nine females mated with the same male two years in succession, and two of these nine mated with the same male in three successive seasons. Change of mates was largely due to female movements since males returned to the same approximate area year after year. Of the six males whose females relocated and mated with other males, one made a territory shift of 80 feet (center to center); one remained in the same place but showed a slight decrease in territory size; one remained in position and showed an increase

in territory size; and three held territories with approximately the same boundaries as in the previous year.

In one case a female which had already chosen a nesting area and which had been there for two weeks suddenly moved to another territory to nest, even though a male was available on the first territory. A male was removed from his territory on May 12, 1950; the next day a neighboring male moved into the vacant territory, thus expanding the latter's holdings. One of his females, which had not yet nested and which he was actively courting, came with him. At the same time he showed an active interest in the resident female which had been present for 12 days: he flew to her again and again, gave song-spread, and remained near her. She persistently kept low in the vegetation as if to avoid him; after two days on the territory with him and his mate, she gradually moved into a third adjoining territory against some opposition by its owner. She was finally accepted by the latter male and nested successfully in his territory.

Females sometimes built nests and even laid several times in different places before bringing off a brood. They sometimes kept within the territory boundaries of their mates, but often they moved beyond them. In 1949, a female twice nested unsuccessfully within one territory, and then moved to

TABLE I

RELOCATION DISTANCE OF 30 NESTS.

Each figure shows the distance from the nest-site of the same female in a previous year, except for A and F, in which one year is skipped. Figures in heavy type indicate cases in which females mated with other males even though their former mates were present on the marsh.

Females	1949	1950	1951	1952	1953
A	?	80			
B	20	40			
C		100			
D		**66**			
E	30	**200**	**34**	6	
F	**100**	180	40	?	100
G	24	6			
H	14				
I		76	10		
J			76	4	46
K			**16**	30	**50**
L			**70**	50	
M			46		
N			**46**	**240**	
O			**160**		

another territory 225 feet away where she nested successfully, and to which she returned the next season. Generally when females move across territory boundaries to renest they necessarily mate with new males. In one case, however, a female remained with her mate even though she nested on an adjacent territory (Fig. 3). In May, 1950, female I1 deserted a completed nest for unknown reasons, and renested successfully in an adjacent territory (H), though retaining her original mate (I). Her encroachment was not observed by me but on at least one occasion I saw male H chase her. Occasionally female I1 was joined by her mate; apparently the tolerance

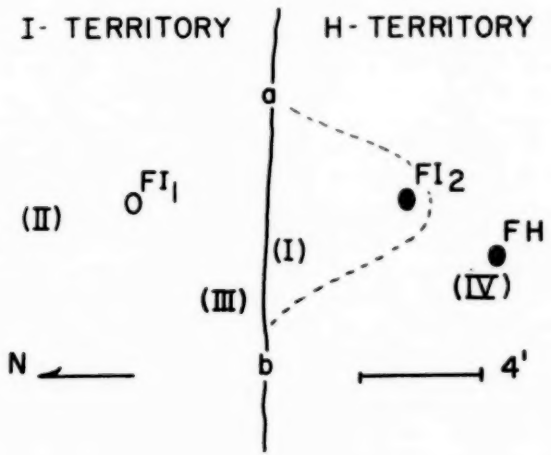

FIG. 3. Map illustrating boundary relationships after female renested in an adjacent territory. A female (FI) deserted her nest in I territory (FI_1) and renested in H territory (FI_2), placing a section of boundary *a–b* in questionable status. A caged young from the nest in H territory (FH), when placed at the positions indicated by Roman numerals in parentheses, drew the following reactions:

(I). Male I and female I remained on the area enclosed by the dashed line when female H first visited the area to feed her caged offspring, but only female I offered any resistance. One minute later male I withdrew before an attack by male H and both male H and female H occupied the area.

(II). Male H halted at line *a–b*; female H attempted to reach her young, but was routed each time by male I (and harassed by female I). Female H was unable to reach her offspring during 30 minutes.

(III). For 10 minutes female H was unable to reach her young. Male I remained perched between the young and its parents (MH, FH) facing them across the line *a–b*.

(IV). Male H and female H at once visited their young without any interference.

shown by the resident male to the intruding female was partly extended to the latter's mate. Results obtained from experimentally moving a fledgling showed, however, that the original territory boundary had not shifted and was recognized by both males. Hence the nest in question was actually located on a foreign territory.

This observation agrees with conclusions reached by experimental transportation of nests across territory boundaries. Under these conditions males accepted females which became familiar through repeated contact (Nero and Emlen, 1951:113). Somewhat similar observations have been reported in other species. Nice (1943:188), particularly, tells in detail how a female Song Sparrow, which built her fourth nest on a neighbor's territory, fought with the male owner and finally dominated him. Her mate later also fought the male and by that means procured the area of her nest as part of his territory. In the case I described above, although male I was occasionally tolerated within H's territory, male I did not claim any of the latter's territory. In the succeeding year female I1 left male I and bred on H territory with a new male which had succeeded in ousting male H.

Two females which had their nests with eggs or young experimentally transferred and left in foreign territories, nevertheless remained with their original mates (Nero and Emlen, *loc. cit*). One of these females led her young back to her own territory after they fledged, then led them off the marsh. She later returned to the original territory to nest for a second time with her mate. This is surprising, considering the amount of disturbance she was subjected to in her first nesting. In a similar case in the Snow Bunting (*Plectrophenax nivalis*) a female built a nest outside of her mate's territory. After a few days the male joined her, attacked the original owner, and after two days' fighting seized the area in the vicinity of the nest (Tinbergen, 1939:31). On the other hand, in one extraordinary case, a female Redwing, which had already built a nest, deserted her mate when a second male stole a portion of the territory which included the nest site. The female stayed with the second male, brought off her young, and later returned for a second brood with her new mate (see p. 139).

Howard (1952:54–55) tells how one pair of Great Tits (*Parus major*) nested in a nest-box which was in the territory of another pair. They flew straight from the nest-box to their own territory, never perching anywhere else within the strange territory. Nest material was gathered out of the territory and neither the male nor the female ever uttered a note or displayed when the resident male visited their nest. The latter made no objection to their presence. "There *were* no boundary lines, for the strangers made no claim to land . . . all they wanted was the nesting box, for they had no suitable hole in their territory."

Summary

Males established territories on the breeding marsh from which all Redwings except the mate, and sometimes other species of birds, were aggressively repelled. Returning males often held the same or nearly the same area year after year. The average size of the territories was about one-twelfth of an acre. Incomplete territorial behavior in migrants was shown by males settling for short periods in the tops of trees in non-nesting areas near the marsh.

When adjacent territories were held by former neighbors, aggression was minimal, but new males created considerable disturbance. Territory boundaries were well-defined and usually remained in approximately the same position throughout the breeding period. New males obtained territories by moving into vacant areas, by "challenging" and forcing withdrawal or eviction through persistent attack, and also through sheer dominance. In one case a male seized a portion of a territory including a female and nest. Throughout the breeding period new males appeared and contested for vacated areas.

First-year males do not generally breed, but occasionally they held territories for short periods, and to a large extent were treated as adults by the territorial adults.

Females met the males on their territories and formed "sub-territories" within the boundaries of their mate's territory. Females were restricted to the mate's territory by the aggressive reactions of adjacent males. Considerable quarreling occurred among females within a male's territory over female-territories and later over actual nest-sites. Females also showed some seasonal persistence in nesting-sites, but frequently changed sites, as well as mates.

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GENERAL NOTES

A case of microphthalmia in the American Robin.—In the spring of 1953 a pair of American Robins (*Turdus migratorius*) at East Lansing, Michigan, raised a completely blind microphthalmic nestling to nest-leaving age. Though anophthalmia (eyelessness) and microphthalmia (small eyes) have been fairly widely reported in genetical literature dealing with laboratory and domestic animals, I have not been able to find any previous record of their occurrence in strictly wild birds.

The history of this unusual individual is as follows: On June 9, 1953, Dr. William M. Seaman, of the Department of Foreign Languages at Michigan State University, called me regarding a nest of robins which his family had watched with great interest in a conifer tree beside their house. At nest-leaving time it was noted that one of the four fledglings was apparently blind, for it blundered helplessly into obstacles in its path. Twice it was rescued from a pool in the yard. Examination of the captured bird disclosed that the orbital region was depressed and completely feathered over. Otherwise the bird appeared to be of normal size and development for a young robin of nest-leaving age. It was kept captive and hand-fed for nine days, but feeding posed a problem because it could not see to take food voluntarily and the constantly bobbing and weaving head was an exasperating and often-missed target.

Post-mortem examination disclosed that concealed eyes were present. The right eyelid appeared to be sealed with an underlying opaque tissue. The eyeball within was approximately 3 mm. in diameter (3.5 × 2.5), complete with lens, but about one-fourth normal size. (A full grown robin of unknown age but still in juvenal plumage, examined for comparison, had eyeballs that were 12–13 mm. in diameter.) The left eyelid could be pried open slightly. This eyeball was 6 mm. in diameter (one-half normal size), but was flattened and had no lens. Thus vision in the ordinary sense seemed out of the question, for the eyelid of the smaller eye appeared to be sealed shut, and the other eye, which possibly had openable lids, had no lens.

Various eye defects, including unilateral anophthalmia and microphthalmia, are of course frequent in animals, especially laboratory stock. These are usually non-genetic, and are due to various accidents in development. But bilateral microphthalmia is known from breeding experiments to be hereditary, resulting from homozygous recessive genes. This condition has been observed and studied in white rats and mice, guinea pigs, rabbits, and domestic pigs. A fairly complete bibliography of the mammalian literature on the subject is presented by Chase (1945. *Jour. Comp. Neurol.*, 83:121–139). Microphthalmia in birds was first studied by Jeffrey (1941. *Jour. Heredity*, 32:310–312), who reared microphthalmic Barred Plymouth Rock (*Gallus gallus*) chicks from parents of known heterozygous stock (carriers). The microphthalmic chicks, produced in an approximately 3:1 ratio, had eyes about one-half developed, but entirely concealed, at hatching time. About half the potential offspring died in the embryo; the others died soon after birth as they could not see to feed. None was reared by hand feeding.

Later, Hollander (1948. *Jour. Heredity*, 39:289–292) progeny-tested a pair of pigeons known to be carriers of microphthalmia and systematically studied the offspring, even succeeding in raising one fertile female (letter of August 7, 1954). Dr. Konrad Lorenz, who has carried out large-scale behavior studies on semi-wild ducks in Germany, tells me that microphthalmic individuals have appeared occasionally in his stock and that the young, in some cases at least, have been able to feed themselves. He suggests that ducks, probing about underwater for their food, may be less dependent on vision and employ a tactile sense in making contact with submerged foods.

In the case of the young robin here described several provocative thoughts arise. In the first place, *both* parents, though appearing normal, must have been carriers of the eye defect in order to produce an offspring with a homozygous recessive trait. The chances of two such adults meeting and mating in the wild are of course unknown. It seems remarkable also that the defective offspring lived as long as it did. It survived approximately 13 days of embryonic development (where it had only a 50 per cent chance of living), was successfully cared for during another 10 to 14 days of nest life, and left the nest with its three normal nest mates. How much longer, if at all, the parents would have cared for their blind offspring is conjecture, but it presumably would have soon fallen prey to some mishap.

Though I can find no other records of microphthalmia among wild birds, one wonders if carriers of the defective gene are not of common occurrence, but that two such adults seldom mate and produce young, or if they do the blind offspring (theoretically one-fourth of the brood) would not survive long enough to be detected. Possibly an examination of a large series of nestlings, or unhatched eggs which failed to hatch because of the semilethal gene, would disclose that the condition is more common than heretofore known.—GEORGE J. WALLACE, *Department of Zoology, Michigan State University, East Lansing, Michigan, August 1, 1955.*

Bird Records for Utah.—The recent accumulation of some bird records for Utah that are not listed in the two check-lists for the state (Behle, 1944. *Condor*, 46:67–87, and Woodbury, Cottam and Sugden, 1949. *Bull. Univ. Utah*, 39:1–40) has prompted us to record them in the literature. All specimens, with the exception of one in the Weber College collection, which will be so designated (WC), are in the University of Utah Museum of Zoology. All specimens unless otherwise designated were collected by the authors. We are grateful to Herbert Friedmann and Gorman M. Bond of the United States National Museum and to Alden H. Miller of the Museum of Vertebrate Zoology, University of California, for the identification of some of these specimens. Our thanks also are extended to Howard Knight of Weber College and Robert J. Erwin of Ogden, Utah, for the use of the data from the specimen at Weber College.

Buteo jamaicensis kriderii.—Red-tailed Hawk. Parker and Johnson in their check-list of Utah bird eggs (published privately about 1899, *fide* Woodbury, *et al.*: 36) reported this subspecies as nesting in Utah. It is now known that the breeding range of this race does not extend into Utah (Friedmann, 1950. *U. S. Nat. Mus. Bull.*, 50:258). Two specimens of this subspecies recently collected in Utah indicate this race to be a fall migrant and possibly a winter resident within the state. One immature male hawk was found dead on October 15, 1951, (WC) by Robert J. Erwin at Willard Bay, 4200 feet, Box Elder County, while the other, also an immature, was collected on August 24, 1953, by Heber H. Hall at Kings Pasture, 9000 feet, Garfield County. The subspecific status of these two birds was verified by Herbert Friedmann.

Calypte costae.—Costa Hummingbird. Although this bird has been observed several times in the Virgin River Valley, only two specimens are known from the state (Behle, 1943. *Bull. Univ. Utah*, 34:41). The collection of a Costa Hummingbird by Heber H. Hall in Garfield County, during the spring of 1953, represents a 100-mile northward extension of range for this species in Utah.

Empidonax traillii traillii.—Traill Flycatcher. In Utah the Traill Flycatcher is represented by two resident subspecies, *E. t. brewsteri*, which is found throughout most of the state, and *E. t. extimus*, which is a breeding bird of the Virgin River valley (Woodbury, *et al.*, 1949:20). The collection of a northern migrant (*E. t. traillii*) on May 25,

1954, at Orr's Ranch, Tooele County, constitutes a first record of occurrence in Utah for the nominate race. The subspecific determination for this specimen was made by Gorman M. Bond.

Anthus spinoletta rubescens.—Water Pipit. Although Woodbury, *et al.* (1949:26) have reported this subspecies as being a sparse migrant and winter resident in Utah, very few specimens exist for the state. Gorman M. Bond identified two specimens recently collected in Utah as *A. s. rubescens.* One was collected at Orr's Ranch, Skull Valley, on May 1, 1954, and another secured on May 12, 1954, at Government Creek marsh, 4 miles north of Camel Back Mountain, both in Tooele County.

Vireo griseus noveboracensis.—White-eyed Vireo. A specimen which proved to be this species was secured by Heber H. Hall eight miles west of Boulder, Garfield County, on May 11, 1953. It was taken from a mixed-species flock of birds in a fruit orchard. This is apparently the first record of the White-eyed Vireo from Utah. Since this species normally ranges east of the Great Plains, the specimen reported here and the one collected August 24, 1933, at Cyanthanis, Cochise County, Arizona (Bent, 1950. *U. S. Nat. Mus. Bull.*, 197:237) constitute the only records to our knowledge of this species west of the Rocky Mountains. The Utah specimen was assigned to *V. g. noveboracensis* by Herbert Friedmann.

Oporornis agilis.—Connecticut Warbler. Not only does the occurrence of this warbler in Utah establish a new record for the state, but it also represents the only known occurrence west of the Rocky Mountains. A specimen collected from Lincoln County (Aiken, 1900. *Auk*, 17:298) in eastern Colorado on May 24, 1899, was formerly the western-most record in this country. The Utah specimen was obtained from the ground beneath dogwood (*Cornus stolonifera*) and willows (*Salix* sp.), of a lower streamside community at the mouth of South Willow Canyon, 5200 feet, 10 miles south of Grantsville in Tooele County, on September 22, 1954.

It is possible that individuals from the populations of this warbler in Alberta, Canada, (Bent, 1953. *U. S. Nat. Mus. Bull.*, 203:522) occasionally pass through Utah and other western states during migration, and due to the lack of collecting during periods of migration and also because of their similarity to the Tolmie Warbler (*Oporornis tolmiei*) they have been overlooked. Further collecting is needed to check this possibility. This specimen was determined by Gorman M. Bond.

Seiurus noveboracensis limnaeus.—Northern Water Thrush. A Water Thrush taken on May 16, 1954, from the edge of a pond at Orr's Ranch, Skull Valley, Tooele County, is the second record of *S. n. limnaeus* from Utah. Behle and Selander (1952. *Wilson Bull.*, 64:30) reported an atypical specimen of *S. n. limnaeus* taken on May 10, 1949, at Farmington Bay Waterfowl Refuge in Davis County. A specimen of *S. n. notabilis*, which was with the aforementioned Skull Valley bird, was also collected. The determinations for these two specimens were verified by Alden H. Miller and Gorman M. Bond.

Passerculus sandwichensis anthinus.—Savannah Sparrow. This northern race is known in Utah from only two records, one collected on October 2, 1888, by Bailey (Woodbury, *et al.*, 1949:33) and another taken on December 19, 1939, by Behle (1943. *Bull. Univ. Utah*, 34:74). The collection of three additional specimens at Orr's Ranch, Skull Valley, Tooele County, during spring migration (April 13, 14 and 21, 1954) would seem to indicate that this race is more common in Utah during migration than was formerly thought. Gorman M. Bond and Alden H. Miller identified these sparrows for us. —RICHARD D. PORTER AND JOHN B. BUSHMAN, *Department of Zoology, University of Utah, Salt Lake City, Utah, August 31, 1955.*

Sparrow Hawk preys upon American Robin.—On July 16, 1955, while driving north on Dale Drive near Silver Spring, Montgomery County, Maryland, I saw a male Sparrow Hawk (*Falco sparverius*) fly low across the road in front of me carrying in its talons, gripped by the anterior part of the breast, an adult American Robin (*Turdus migratorius*).

The screaming hawk was pursued closely by two adult robins which called excitedly and, at one time, pulled up parallel with it, without venturing to attack the small raptor. The hawk and its pursuers went out of sight behind an evergreen tree.

I had parked my car and was walking back to investigate when the hawk, which had doubled back on its path, crossed the road again still carrying its prey with the two protesting robins close behind. The hawk was not more than 10 feet above the ground, and its flight was labored from the weight of its prey. This group of three birds swerved behind another evergreen, and I could not locate them again.

The literature shows that robins are among the heaviest birds taken by Sparrow Hawks. John B. May (1935. "The Hawks of North America") recorded meadowlarks (*Sturnella neglecta*) and Brewer's Blackbirds (*Euphagus cyanocephalus*) as the largest birds taken by Sparrow Hawks in the western United States. A. K. Fisher (1893. *Bull. No. 3, U. S. Dept. Agric., Div. Ornith. and Mammal.*) listed the Bobwhite Quail (*Colinus virginianus*), Starling (*Sturnus vulgaris*), and Red-winged Blackbird (*Agelaius phoeniceus*) among the small birds identified in stomach content examinations of these hawks.

However, the identification of the prey is often based upon stomach content remains or else the observation does not indicate that the hawk was seen in flight carrying its prey. More rarely, records of the hawk apparently carrying its prey are published. May (*op. cit.*) stated that "John Steidl (1928) saw a Sparrow Hawk several times with two-weeks-old chickens in its talons."

Use of some of the data from the bird weight files of the U. S. Fish and Wildlife Service makes it possible to compare approximate weight relationships of the Sparrow Hawk and its avian prey: Sparrow Hawk, 83 to 140 grams; Bob-white, 195 to 198 grams; Eastern Meadowlark (*Sturnella magna*), 145 grams; Robin, 74 to 85 grams; Starling, 84 grams; and Red-winged Blackbird, 70 to 73 grams. I was informed at the Poultry Department of the University of Maryland that for rapidly-growing breeds of chickens, a two-weeks-old bird would probably weigh between 140 and 160 grams, as compared to 130 to 140 grams for a two-weeks-old bird of a breed that grows slowly. Sparrow Hawks have not been seen carrying prey species appreciably heavier than themselves, even though they are known to feed on larger birds.—Donald Lamore, *2C Garden Way, Greenbelt, Maryland, August 16, 1955.*

Preening and other behavior of a captive Horned Grebe.—On March 20, 1955, I captured a molting Horned Grebe (*Colymbus auritus cornutus*) at Island Beach State Park, Ocean County, New Jersey. The breast feathers were soaked with oil which I removed with a detergent and mineral oil. The bird lived for eight days; the following observations were made in this period.

Preening.—After the oil was removed, the grebe was placed on the floor where it immediately began to preen. The tameness of the bird allowed close observation. The grebe preened for 40 minutes without interruption, slept for 10 minutes, and then preened for 20 minutes more before it went to sleep for a more extended period. Preening began with the feathers of the back and wings. First the grebe removed the water from these feathers. This was done by manipulating the bill along small bunches

of feathers, from base to tip. After the bird did this several times it shook its head vigorously, spraying water around the room. The bill made a snapping sound when this was done. After removing water for 20 minutes, the bird began to use the oil gland. The upper tail coverts were erected and the nipple of the gland seemed to be protruded several millimeters. The bird manipulated its bill over the nipple from the base to the tuft of feathers at the tip. I saw oil exude from the pore on to the tuft from which it was picked up on, and probably in, the bill. The oil was worked into the feathers with a method similar to that used in cleaning and drying. The primaries were preened only once.

The feathers of the flanks and neck were next to be preened. The procedure was the same: cleaning and drying first, and then oiling. Sheaths and bits of feathers accumulated at the corners of the bird's mouth, and sometimes entire feathers (mostly worn, gray winter feathers) were dislodged. These were quickly discarded. The head was often rubbed over the oil gland, but only following "milking" of the nipple by the bill. After doing this the bird usually rubbed its head over the scapular feathers. This may have been done to adjust the feathers of the head, many of which were disarranged. The bird did not preen its white breast and belly feathers until the following day, after bathing. The grebe pushed itself over on one side, grasped a transverse row of feathers in its bill, extracted the dirt and water as described above, and then applied oil. The entire breast was preened in this way.

Bathing.—On March 21, I placed the grebe in a bathtub. A platform was put in the tub and tap water was brought up to this level. When placed in the tub the bird first drank, then bathed. The scapular feathers were elevated, the head immersed and quickly brought over the back. Several applications of water were followed by vigorous shaking. Paddling strongly, but remaining in place, the bird rose high in the water and shook. The wings were often flapped when this was done. The bird soon became waterlogged and climbed on to the platform. The first few attempts at getting out of the water were difficult for the bird, but it soon became adept. It faced the platform, its chest a few inches from it, stroked the water with both feet and jumped to a standing position.

Sleeping.—The bird slept only on the platform. When sleeping the bill was tucked forward into the feathers at the base of the neck, and the feet were sometimes raised and placed on the flank feathers. In the water, this sleeping position would reduce heat loss from the poorly-insulated feet.

Molting.—The grebe was in prenuptial molt when captured. On March 20, the only evidence of breeding plumage was scattered rufous flank feathers and some golden feathers of the "horns." Eight days later, when the grebe died, more of these feathers had appeared and the white feathers of the throat and cheeks were almost entirely replaced by black ones. Rufous feathers had become numerous on the neck where none had been evident, and many new feathers had appeared on the crown. A few feathers of the scapular tract were also replaced. Other Horned Grebes in the area were in a similar stage of molt.

Walking.—On a sunny day I placed the grebe in the yard hoping to observe sun bathing, but this did not occur. Standing upright, the grebe wandered in different directions. It was able to go 15 to 20 feet before flopping down on its breast.

Voice.—The bird called often. The note was a short, one-, or two-syllabled, plaintive "aow." It was high pitched, matching B flat, above middle C on a piano.

Feeding.—The bird was fed strips of squid (*Loligo*) for four days. The first five

pieces had to be pushed down the esophagus with forceps, but thereafter the grebe ate eagerly. It snatched food dangled or placed before it, but never went after food at the bottom of the tub. When I prepared to feed the grebe it became excited and frequently called. Strips of squid wider than 25 millimeters were swallowed only with considerable difficulty. On March 26, my supply of squid was gone so I bought some frozen sand launces (*Ammodytes americanus*), used locally for fishing bait. The first half dozen were taken by the grebe with the usual avidity, but it soon refused to eat them. No other food was obtainable and the bird was found dead on March 28. The stomach contained numerous feathers, none of which I had seen being swallowed.

When the bird defecated while on the platform it always backed up a few steps. The grebe was seen scratching its head twice. It did not place its foot over the wing to do this. The bird was a male (testes 6×3 mm.). It had little fat and weighed 387 grams when it died.

F. I. Dewald and John Verdier of the New Jersey parks commission kindly granted me access to Island Beach.—GLEN E. WOOLFENDEN, *Museum of Natural History, University of Kansas, Lawrence, Kansas, September 1, 1955.*

Connecticut Warbler in Kansas.—Among 230 birds killed by striking a television transmitting tower one mile west of Topeka, Shawnee County, Kansas, on the night of September 22–23, 1955, was an immature male Connecticut Warbler (*Oporornis agilis*). The birds were collected by members of the Topeka Audubon Society and given to the University of Kansas. The Connecticut Warbler (KU 32622) is the first record of the species in Kansas authenticated by a specimen. Wetmore reported this species from the state in 1909 (*Condor*, 11:162), but in 1920 (Condor, 22:158–159) stated that the specimen reported earlier was actually an immature Mourning Warbler (*Oporornis philadelphia*), a species of regular occurrence in Kansas. T. W. Nelson and L. B. Carson (*Topeka Audubon News*, 3(4), July, 1949) reported seeing a male Connecticut Warbler in Topeka on May 1, 1949. I know of no other records of the species in Kansas.

Occurrence of the Connecticut Warbler in Kansas in autumn is of special interest because the species normally migrates east of the Alleghany Mountains in fall, returning north in spring through the Mississippi Valley. The specimen from Kansas weighed 14.9 grams, was moderately fat, and had an incompletely ossified skull. Measurements were: wing (chord), 71 mm.; tail, 48 mm.—HARRISON B. TORDOFF, *Museum of Natural History, University of Kansas, Lawrence, Kansas, September 29, 1955.*

Tree Swallows playing with a feather.—On October 23, 1955, while watching ducks on the Boonton Reservoir, Boonton, New Jersey, I saw a white object drop from the sky and float on the surface of the water. Puzzled as to what it could be, I continued to watch it and then saw a Tree Swallow (*Iridoprocne bicolor*) scoop it up and fly off with it. This bird was pursued by four or five other Tree Swallows and, in his effort to evade them, he twisted and turned violently, finally dropping what I could see was a feather about four inches long.

Another Tree Swallow picked the feather up from the surface and the action was resumed. This same sequence of events occurred three or four times. Finally, one swallow dropped it but as the feather floated and twisted toward the water one and then another swallow tried unsuccessfully to pick it out of the air. Their failure was quite interesting to watch for they had always succeeded in taking it off the surface of the water. It occurred to me that pursuit of a slowly dropping object might have been more difficult and strange than catching insects.

After several birds had missed the feather, one caught it in mid-air and the chase continued. Apparently, picking it out of the air was more fun than taking it off the surface of the water, for thereafter the swallows generally tried to get it in mid-air. This observation lasted several minutes. At this time there were hundreds of Tree Swallows over the reservoir but only about a half-dozen were playing with the feather. —CHARLES W. LINCOLN, *392 Highland Avenue, Upper Montclair, New Jersey, October 24, 1955.*

Nesting heights of some woodland warblers in Maine.—During 17 summers at the Audubon Camp on Hog Island (and adjacent mainland) in Lincoln County, Maine, we found a great many nests. I kept a record of the height from the ground of many of the nests of woodland warblers (Parulidae) and tabulate herewith the accumulated data. The heights reported for the lower nests represent actual measurements. The remainder, although estimates, were obtained mostly with the aid of a camera range finder and may be considered reasonably accurate.

Species	Total nests	Height of the nests from the ground (in feet) 0-5	5-10	10-15	15-20	20-30	30-40	40+	lowest	highest
Parula Warbler	71	0	7	16	22	9	11	6	$5\frac{2}{12}$	54
Magnolia Warbler	33	18	13	2	0	0	0	0	$1\frac{1}{12}$	14
Myrtle Warbler	44	0	4	12	17	6	2	3	$6\frac{2}{12}$	43
Black-throated Green Warbler	58	1	5	15	19	10	6	2	3	51
Blackburnian Warbler	7	0	0	0	0	0	0	7	43	76
Bay-breasted Warbler	4	0	1	2	1	0	0	0	$7\frac{2}{12}$	16
American Redstart	50	2	6	18	11	5	6	2	$1\frac{1}{12}$	52

The study area is located in red spruce (*Picea rubens*) and white spruce (*P. glauca*) woodlands or in mixed spruce and hardwood forests. All the nests of the Parula Warbler (*Parula americana*) were located in *Usnea* lichen. All nests of the Magnolia (*Dendroica magnolia*), Myrtle (*D. coronata*), Blackburnian (*D. fusca*), and Bay-breasted (*D. castanea*) warblers were located in red or white spruce or in balsam-fir (*Abies balsamea*). Nearly all the Black-throated Green Warblers (*D. virens*) nested in conifers, whereas all but two of the American Redstarts' (*Setophaga ruticilla*) nests were found in deciduous growth.—ALLAN D. CRUICKSHANK, *R.R. 1, Box 1590, Rockledge, Florida, October 18, 1955.*

Nest-building movements performed by a juvenile Olive-backed Thrush.—A captive juvenile Olive-backed Thrush (*Hylocichla ustulata*), when approximately 17 days old and while snuggling down into my wife's cupped hands, performed perfectly typical nest-shaping movements characteristic of adult females. The bird simultaneously kicked backward with both feet and forcibly thrust its breast against the side of the cup. The wings were held rather high on the back but not unfolded and the tail was rather depressed. The bird would perform a few rapid thrusts and kicks and then turn slightly in the cup and repeat these acts. It fell asleep after a few such attempts.

Several hours later I held this bird in my cupped hands in order to see if I could observe this behavior pattern again. The performance was repeated and by increasing

a gentle pressure with the edge of my hand against the pushing breast I could provoke an increased effort at this particular spot. It would seem likely that the irregularities of a nest as it is being shaped provide a tactile-proprioceptive stimulus to the bird's breast which acts as a releaser for the thrusting response; the thrusting ceases when the nest fits as the thrusting ceased when I allowed the bird to "push" my hand into shape.

Other similar observations have been made; for example, D. Goodwin, (1954. *British Birds*, 47:81–83) describes nest-building movements performed by juvenile Mistle Thrushes (*Turdus viscivorus*). These observations indicate that the innate releasing mechanisms responsible for reacting to nest-building releasing stimuli must be present at an early age. These precocious behavior patterns are probably not observed more often because of lack of observers and because the stimuli releasing these acts seldom are available to juvenile birds, which, in any case, must have a low state of internal readiness to perform patterns of behavior associated with nest building and other reproductive activities.—WILLIAM C. DILGER, *St. Lawrence University, Canton, New York, October 22, 1955.*

Water moccasin as a predator on birds.—During field investigations of rails in the coastal marshes of Cameron Parish, Louisiana, a water moccasin, *Agkistrodon piscivorus*, with an engorged digestive tract was observed and collected on April 13, 1955. Upon dissection a male Sora Rail (*Porzana carolina*) was found in a fairly fresh condition with only the head and forequarters digested.

On October 13, 1955, in the same locality, a water moccasin was collected and found to contain the feathers, feet and bill of a Seaside Sparrow (*Ammospiza maritima*).—WILLIAM H. ADAMS, JR., *Department of Forestry and Game Management, Louisiana State University, Baton Rouge, Louisiana, October 25, 1955.*

Pleistocene Birds from Crystal Springs, Florida.—Among several lots of fossil birds submitted to me for identification by S. J. Olsen of the Museum of Comparative Zoology are three specimens from Crystal Springs run, in the southeastern corner of Pasco County, Florida. This material was collected on June 4, 1941, by Dr. L. J. Marchand of Gainesville. The bones are well mineralized and resemble Pleistocene material from other Florida spring deposits; all represent living species.

Anas carolinensis. Green-winged Teal. Left humerus. Recorded from the Pleistocene at Seminole Field, Florida (Wetmore, 1931. *Smithsonian Misc. Coll.*, 85(2):21), as well as from several localities in the western United States.

Aythya collaris. Ring-necked Duck. Left carpometacarpus. The previous fossil records of this species are somewhat unsatisfactory. Shufeldt (1913. *Bull. Amer. Mus. Nat. Hist.*, 32:156) recorded it with a query from Fossil Lake, Oregon, and Howard (1946. *Carnegie Inst. Wash. Publ.*, 551:174, 191) also queried the determination. Wetmore (1940. *Smithsonian Misc. Coll.*, 99(4):26) listed it from the Lower Pliocene of Nevada. This record is based on a report by Merriam (1916. *Univ. Calif. Publ. Dept. Geol. Sci.*, 9:173), whose specimens were so fragmentary that it would have been preferable to confirm the determination with better material before extending the record of living species of birds back to the Lower Pliocene.

Aramus guarauna. Limpkin. Right carpometacarpus. Previously recorded from two Pleistocene localities in Florida (Wetmore, 1931).—PIERCE BRODKORB, *Department of Biology, University of Florida, Gainesville, Florida, November 11, 1955.*

Singing and window-fighting by female Cardinals.—On three occasions in the last 25 years I have observed female Cardinals (*Richmondena cardinalis*) exhibiting behavior usually considered characteristic of the males. One of these females was singing only a part of the Cardinal song, the second engaged in window-fighting, and the third sang a large part of the Cardinal repertory. The first singing bird built a nest in a privet (*Ligustrum* sp.) in a small unpaved corner of a paved court at Vanderbilt University, Nashville, Tennessee, in early May, 1930. This court was enclosed by walls 35 feet high. The nest which was about seven feet above the floor of the court was built largely of small pieces of newspaper and twigs which this bird carried over the top of the building. As the nest location was only about five feet outside my dormitory window, I was able to watch from the semi-dark room as though from a blind. On several occasions during nest construction by the female the male Cardinal sang the "what cheer" beginning of the song (repeated two or three times) from his perch in the privet above the nest and the female immediately answered with, "cheaper," "cheaper," "cheaper," "cheaper," from the floor of the court where she was gleaning small privet twigs, plucked and dropped by the male.

For several days in mid-May, 1945, at the Cranbrook Institute of Science, Bloomfield Hills, Michigan, I watched a pair of Cardinals through the window of a darkened room. These birds were in the branches of a 12-foot hawthorn (*Crataegus* sp.) whose branch tips brushed against the window. From about 2:00 to 5:00 p.m. each day for about a week the female of this pair vigorously attacked with wings and beak her reflection in the lower part of the window while the male sat on a branch within a few feet uttering call notes. Neither bird sang during any of these performances and only the female was seen engaged in window-fighting. A photographic record in 16 mm. colored motion pictures was taken of this behavior. This female built a nest in the hawthorn, beginning about the time her window-fighting ended.

On July 17, 1955, I found another Cardinal's nest, also on the Cranbrook Estate. The female was sitting on two small young and one egg, and left the nest reluctantly. She flew immediately to another bush about 15 feet away and sang almost the full song of the species 11 times in about five minutes. Her state of excitement was evident in the greatly increased tempo of each song sequence. When I walked away from the nest to a distance of about 30 feet, her singing ceased and she began to utter the usual call notes. While the female sang the male sat a few feet away uttering the familiar "chip" notes but otherwise apparently little excited. It will be noted that both instances of the female's singing and one of window-fighting were related in order, to nest building, choice of nest site, and nest protection.—WALTER P. NICKELL, *Cranbrook Institute of Science, Bloomfield Hills, Michigan, October 13, 1955.*

Vertical nest placement in the Blue-gray Gnatcatcher.—The nest placement of the Blue-gray Gnatcatcher (*Polioptila caerulea*) is generally described in the literature as resting on, or saddled on horizontal branches either under or attached to another upright or diagonal branch. This, apparently, is the usual placement (Fig. 1). The horizontal branching habit found in most taller trees in wooded habitats furnishes a minimum number of suitable upright crotches for nest placement while open, low shrub growth furnishes an abundance of such sites. This is attested by use of the latter by such abundant nesting birds as the Yellow Warbler (*Dendroica petechia*), Alder Flycatcher (*Empidonax traillii*), Indigo Bunting (*Passerina cyanea*), Common Goldfinch (*Spinus tristis*), Field Sparrow (*Spizella pusilla*) and Catbird (*Dumetella carolinensis*). J. J. Murray at Lexington, Virginia, (1934. *Wilson Bull.*, 46:128) reported a nest of

the Blue-gray Gnatcatcher which was "not saddled on a limb but set between three small forks of an upright crotch, in the manner of the nests of the Yellow Warbler and Redstart." R. A. Hallman of Panama City, Florida, (A. C. Bent, 1949. *U. S. Nat. Mus. Bull.*, 196:346) wrote of another nest of this species which was in the "upright fork of a small scrub oak bush, . . . by actual measurement 38 inches . . . from the ground to the top of the nest." These two references to nest placement in upright forks by the Blue-gray Gnatcatcher are the only ones I find in the literature.

FIG. 1. Horizontal (left) and vertical placement of Blue-gray Gnatcatcher nests. Photograph by Luella C. Shroeder.

Recently I found two vertically-placed nests of the Blue-gray Gnatcatcher. A nest placed in an upright crotch of an elm (*Ulmus* sp.) and enclosed by three branches was collected on December 15, 1954, 3 miles west of Aurora, Indiana. The second, found in Oakland County, Michigan, in January, 1955, was enclosed by four upright branches of wild crab (*Pyrus coronaria*). Heights of the rims of the two nests from the ground were 50 and 42 inches, respectively.—WALTER P. NICKELL, *Cranbrook Institute of Science, Bloomfield Hills, Michigan, September 14, 1955.*

WILSON SOCIETY ACTIVITIES

THIRTY-SEVENTH ANNUAL MEETING

The *Proceedings* of the Thirty-seventh Annual Meeting, held at Buffalo, New York, April 26–29, 1956, will be published in the September issue of *The Wilson Bulletin*. The names of the officers elected for the ensuing year appear on the inside front cover of this issue. Elective members of the Executive Council are Harvey I. Fisher, Leonard C. Brecher and Andrew J. Berger. The Council reelected Keith L. Dixon as Editor of *The Wilson Bulletin* and accepted an invitation from the Minnesota Ornithologists' Union, the Duluth Branch of the University of Minnesota and the Duluth Bird Club to hold a mid-June meeting at Duluth in 1957.

RESEARCH GRANTS

Kenneth C. Parkes, Chairman of the Research Grant Committee, reported that two applications for the Louis Agassiz Fuertes Research Grant were judged equally meritorious and deserving. The Council, therefore, made an exception to the general rule and awarded duplicate grants of $100 each to John Burton Millar, University of Wisconsin, whose study is "An investigation of possible factors involved in the initiation of migration" and Lester L. Short, Jr., Cornell University, whose project is "Hybridization and isolating mechanisms in North American Flickers (*Colaptes*)."

Donald R. Altemus, State College, Pennsylvania, was voted an award of $25 from the S. Morris Pell Fund for the encouragement of bird artists. The Chairman of the Research Grant Committee wishes to acknowledge the assistance of William C. Dilger, who is acting as art consultant to the committee.

THE WILSON ORNITHOLOGICAL SOCIETY LIBRARY

The following gifts have been recently received. From:

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Walter E. Scott—1 book, 7 pamphlets
Mrs. J. Murray Speirs—1 reprint
Alexander Sprunt, Jr.—1 reprint
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Lawrence H. Walkinshaw—1 reprint
University of Wisconsin Department of Zoology—3 reprints

ORNITHOLOGICAL LITERATURE

THE HONEY-GUIDES. By Herbert Friedmann. Bulletin 208 of the United States National Museum, Smithsonian Institution, Washington, D.C., 1955: 6×9 in., vii+292 pp., 6 text figures, 20 photographs, 5 color plates by Walter A. Weber.

Along with "The Cowbirds," this book is bound to become an ornithological classic, not only for the unusual interest attached to the subject matter, but for the excellence of the scholarship and detective work it displays. A first opinion might consider that 300 pages is a lot to devote to a preliminary report on an obscure family of birds containing only 11 species, some of them known from only a few specimens and a few casual field observations. A few minutes of perusal will dispel any such delusion, and a thorough study will convince the reader that in this volume Dr. Friedmann has made a highly significant contribution not only to ornithology, but to several facets of animal behavior and even to digestive physiology. In compiling this work Dr. Friedmann consulted or corresponded extensively with most of the active field ornithologists of Africa and Southern Asia. Cooperators and consultants on various aspects of the work included a large number of biologists, bacteriologists, chemists and anatomists. The list of references cited contains 285 titles.

In the first part of the book (83 pages) Dr. Friedmann discusses the basic biological problems raised by the peculiar behavioral characteristics of the honey-guides, particularly their interesting development of brood parasitism, the remarkable "guiding" habit, and wax eating or cerophagy. The second part (181 pages) contains descriptive materials and observations on each of the 11 species known to science. Twenty well-selected and instructive photographs and five beautiful color plates show the characteristics of each of the species and depict various significant aspects of their structure and behavior.

The honey-guides, a small and relatively obscure family of arboreal birds of tropical Africa and southern Asia, belong to the order Piciformes and show their closest affinities with the barbets. The eleven species, largely dull gray in coloration, range in size from two warbler- or tit-sized foliage gleaners (*Prodotiscus*) to the tanager- or waxwing-sized Greater Honey-guide (*Indicator indicator*) of open woodlands and "brushveldt."

Although information is still incomplete on several species, the honey guides are apparently all parasitic in their nesting. In this respect they go farther than any of the other bird families which display this behavioral trait. Friedmann believes the habit probably antedates the evolution of the group into its present generic sections and is older and more advanced than in any other family of birds. A large variety of hosts or victims is selected, most of them, at least for the members of the genus *Indicator*, being hole-nesting species. This specialization on cavity nesters would seem largely to eliminate any elements of competition for hosts with the parasitic cuckoos and ploceids.

Associated with brood parasitism is a reduction in specialized territorial and courtship displays, although several species, notably the remarkable and little known Lyre-tailed Honey-guide (*Melichneutes robustus*), of the tropical forests have interesting flight displays in which rustling noises are produced by the tail feathers. Mating in the Greater and Lesser Honey-guides takes place at call sites or "stud posts" which are occupied by a single male and visited by a series of females apparently for mating purposes only. Several males may use a "stud post" successively or concurrently, singing their simple two-syllabled song, and waiting without evidence of competition. Stud posts are used continuously by singing males year after year, in one case for 20 years.

Unlike the parasitic cuckoos and cowbirds, the honey-guides, typical of their picarian relationships, have long fledging periods; competition with their nestling associates depends on direct action rather than speed of maturation. In two species, at least, nestling aggressiveness is aided by the possession of a pair of sharp-pointed mandibular hooks which may be used with great effectiveness in biting the delicate skins of nest-mates. Nestlings of the Greater Honey-guide have also been observed to evict their nest-mates directly. More than one honey-guide egg in a parasitized nest is rare, and only one fledgling is produced per nest.

The mandibular hooks, like the familiar egg tooth of other birds, are shed during the nestling stage. Special histological studies showed a basic similarity between "hook" and "tooth," and an examination of the bills of nestlings belonging to other picarian species reveals that this peculiar structure is not wholly without homologous counterparts in the barbets and woodpeckers.

Perhaps the main objective of the book, and its major contribution to science, is an examination and analysis of the guiding habit as observed in the Greater Honey-guide (*I. indicator*) and occasionally in the Scaly-throated Honey-guide (*I. variegatus*). After reviewing early accounts and interpretations of this remarkable behavior, Friedmann carefully describes all aspects of the performance based on his own experience (23 instances) and the observations of a large number of competent eye witnesses. Typical guiding behavior is summarized as follows: "When the bird is ready to begin guiding it either comes to a person and starts a repetitive series of churring notes, or it stays where it is and begins calling these notes and waits for the human to approach it more closely. These churring notes are very similar to the sound made by shaking a partly-full, small matchbox rapidly lengthwise. If the bird comes to the person to start leading him, it flies about within 15 to 50 feet from him, calling constantly, and fanning its tail, displaying the white outer rectrices. If it waits for the potential follower to approach it for the trip to begin, it usually perches on a fairly conspicuous branch, churring rapidly, fanning its tail, and slightly arching and ruffling its wings so that at times its yellow "shoulder" bands are visible. As the person comes to within 15 to 50 feet from it, the bird flies off with an initial conspicuous downward dip, with its lateral rectrices widely spread, and then goes off to another tree, not necessarily in sight of the follower, in fact more often out of sight than not. Then it waits there, churring loudly until the follower again nears it, when the action is repeated. This goes on until the vicinity of a bee's nest is reached. Here the bird often (usually in my experience) suddenly ceases calling and perches quietly in a tree nearby. Some observers record no such cessation of the churring notes when near the bee's nest, but all agree that the bird perches unobtrusively in a nearby tree or shrub and there waits for the follower to open the hive, and it usually remains there until the person has departed with his loot of honeycomb, when it comes down to the plundered bee's nest and begins to feed on the bits of comb left strewn about. The time during which the bird may wait quietly may vary from a few minutes to well over an hour and a half."

Man is not the only symbiont in these cooperative guiding performances. The Honey Badger or Ratel (*Mellivora capensis*) is known to play the role of follower and hive opener at times, and baboons may occasionally participte. Ratels apparently grunt noisily when following a Honey Guide, and natives often make a practice of grunting in a similar manner and beating trees with sticks, believing that in so doing they get better cooperation from the bird.

Of particular interest is the fact that the guiding habit is apparently unknown in certain sections of Africa and has been disappearing in others, particularly near cities where natives can buy their sweets in shops and no longer make a regular practice of following the birds. There is a danger, in fact, that this interesting behavior may disappear except in the remote hinterland where natives continue to contribute their part in the symbiotic relationship.

The peculiar habit of cerophagy or wax-eating is apparently important as a basic element in the evolution of guiding behavior. Formerly thought to be primarily insectivorous birds with special predilections for bees and bee larvae, honey-guides have now been shown to feed extensively and preferentially on beeswax and even to thrive for a month on an exclusive diet of wax. Because of the special problems involved in assimilating and utilizing wax as food, laboratory studies were initiated to determine the chemical changes induced in the digestive tracts of these birds. Preliminary results indicate that either the microflora of the alimentary canal or the endogenous avian enzymes are capable of splitting these waxes into fatty acids of considerably lower molecular weight, so that it becomes possible for the birds to extract nourishment from them.

An interesting discussion is devoted to the "behavioristic level" of the guiding habit and to its antiquity and evolution. "Guiding" is regarded as a dangerous term if it implies purposive or adaptive behavior at the individual level. Friedmann believes that guiding is basically instinctive and stereotyped, although the selection of the symbiont or "guiding kumpan" is probably the result of learning. A study of the routes followed by guiding birds suggests that in many cases, at least, the destination at the hive was not known to the bird at the start of the tour, but was discovered by random searching after the human participant had been enjoined. It is suggested that the sight of a human being or a honey badger may tend to excite a bird which has previously encountered one of these creatures at the site of a freshly opened bee nest. The excitement of the bird results in the approaching and calling behavior characteristic of the first stage of guiding. The human or badger symbiont responds to this calling, presumably through associative memory, and the guiding-following act ensues. The encountering of a swarm of buzzing bees is thought to suppress the bird's excitement and, in terminating the stimulus situation for the follower to lead to localized foraging near the site and the discovery of the hive.

Friedmann believes that the habit is quite old and probably antedates the advent of man. He suggests that the ancestral honey-guides may have been primarily followers rather than guides and have developed a simple functional relationship with other bee predators before any guiding behavior evolved.

In these days when scientific workers struggle and groan under an overwhelming avalanche of scientific publication, there will be some who decry the anecdotal presentation and frequent reiteration to be found in this work. One might wish to see some of the data tabulated and some of the sections summarized in precise phrases; but the subject in general does not lend itself to concise quantitative treatment. Here, in fact, is an admirable example of what the naturalist means when he tells his experimentalist colleagues that much in science can only be presented in narration and description. "The Honey-Guides" is an exhaustive compendium of information, objectively gathered, scientifically organized and ably presented as a record of several remarkable biological phenomena, and as a firm basis for launching further exploration and study.—JOHN T. EMLEN, JR.

A Distributional Check List of the Birds of Illinois. By Harry R. Smith and Paul W. Parmalee. Springfield; Illinois State Museum, Popular Science Series IV, and Illinois Audubon Society, 1955:4⅜ × 7½ in., 62 pp. $.25.

The last previous list of the birds of Illinois was Gault's "Check List of the Birds of Illinois" published by the Illinois Audubon Society in 1922. It was published to "render assistance to observers and students of bird life everywhere in Illinois" and was printed in handy pocket form for the benefit of the field student. The present volume brings Gault's list up to date with the inclusion of all new records of the past 30 years, and retains the useful shape and size of the original. All species recorded are included in a single list, with a short résumé of their abundance in northern, central, and southern Illinois, and, in the case of rarer species, brief notes on recent observations. Common names are those of the forthcoming American Ornithologists' Union Check-List, and when these differ from those of the 1947 edition of Peterson's "A Field Guide to the Birds," the latter are added in small type. Scientific names are to the species level only, as is proper in a work of this type.

Many of the new species added to the list, and indeed several of the old ones that are retained, are based upon sight records only. The authors recognize that they may be open to criticism on this score, and they are careful to point out that "before a new state record should be accepted as scientific data, this record should be based on and verified by a collected specimen. . ." Further, they place an asterisk before the name of a species included solely on the basis of a sight record. Despite these precautions on the part of the authors, there is an unevenness in the value of these records that makes the reviewer wish that at least some of the species had been removed to a hypothetical list. Although the check-list was prepared primarily for the field student, the fact that it is the only recent list of Illinois birds will make it an important source for museum workers, and a more critical evaluation would have been desirable. At least a fuller account of the circumstances surrounding the previously unpublished sight records would have made it possible for the reader to make his own evaluation.

Although it is not possible or proper to review all the doubtful forms, there are a few species to which attention should be drawn. The Mexican Cormorant is considered as being based upon a collected specimen, but the source of this specimen was doubtful, and the species should be considered hypothetical rather than accidental. The Royal Tern and the Gull-billed Tern are both based on unsupported observations of Nelson of 80 years ago, and both forms should go on a hypothetical list. The Brown-headed Nuthatch is based solely upon recollections 40 years old at the time of recording. The same is true of Ridgway's "recollection of what he believes to have been" an Ivory-billed Woodpecker. Certainly some comment is due on the quoted sight records of the Passenger Pigeon reported in 1923, since the last authenticated specimen of that extinct form was collected in 1900. The few recent observations listed under the Snowy Owl are incomplete and give a misleading idea of the relative abundance of that form in years when there is a major flight. The only omission that is apparent is the Long-billed Dowitcher, *Limnodromus scolopaceus*; Pitelka, in his recent monograph (1950, *Univ. Calif. Publ. Zool.*, 50:1–108.) lists specimens of both the Long-billed and Short-billed Dowitchers from Illinois.

The above comments are not meant as a major criticism of a work which is admirably suited for the use for which it was intended. Rather it is to be hoped that the future revisions which the authors promise will contain enough additional information to broaden its usefulness to students outside the state.—Melvin A. Traylor.

MANUAL DE LAS AVES DE EL SALVADOR. By A. L. Rand and Melvin A. Traylor. San Salvador; Universidad de El Salvador, 1954:7⅜ × 9⅝ in., iv + 308 pp., 108 figs. in text. Paper bound; lithoprinted.

The only book on the birds of El Salvador prior to the appearance of this volume was Dickey and van Rossem's monumental "The Birds of El Salvador," published in 1938, a treatise of limited usefulness to Central American ornithologists since it is printed in English and includes no sections on field identification. The present volume, printed in Spanish and containing keys to species and detailed descriptions of each species, makes available a comprehensive volume which should be most useful to Central American ornithologists, whether amateur or professional.

Much of the material presented is taken from Dickey and van Rossem, supplemented by data from J. T. Marshall, Jr.'s paper (1943. *Condor*, 45:21–33) and by the observations and collections made by Rand, who spent six months in El Salvador. The introductory sections cover such topics as topography, climate, vegetation, composition of the avifauna, migration, and breeding. Much of this material has been condensed from Dickey and van Rossem.

Wetmore's classification of families is used. The classification of non-passerines follows Peters, and that of passerines, Hellmayr. Following each family is a brief characterization of the group. Then follows a key for the identification of those species which are found in El Salvador. Appearing under each species are sections on description of adults and young, diagnostic characters, range (both general and in El Salvador), biology (status, relative abundance, habitat, food habits, extreme dates for migrants, and nesting), and lastly a general section on behavior, voice, and related topics. Much of the material in the general sections has been taken from Dickey and van Rossem, and the source of such material is indicated throughout.

Both scientific and vernacular names are given for each species. Where the scientific name differs from that used by Dickey and van Rossem, the latter is given in a footnote, so that the two sets of names can be equated. In a few cases citations are given pertinent to the name changes, but most are unexplained. Many of the vernacular names are awkward translations of the English. How many ornithologists will commit to memory such names as "Colymbo sureño de pico moteado" (Southern Pied-billed Grebe) or "Ave tropical del norte de pico rojo" (Northern Red-billed Tropic-bird)? Such cumbersome vernaculars will undoubtedly force serious students to memorize the scientific names, which is all to the good. The authors should not be criticized adversely for these vernaculars, since translation into Spanish of an already confused set of English names poses almost insuperable problems.

The book contains many of the illustrations by Douglas E. Tibbitts which first appeared in E. R. Blake's "Birds of Mexico." These are fairly well reproduced, although most have been considerably darkened with consequent loss of fine detail.

The chief defect that appears is the treatment of each subspecies, where two or more races of a given species occur in El Salvador, as a separate entity, with its own account. Since most of the races concerned are indistinguishable in the field, it would have been less confusing to have had an over-all account for each species, with a listing of the various races and their distributions in the section on range. The treatment of races as separate entities does not seem compatible with the statement in the introduction that this volume is designed for the non-specialized reader.

It seems obvious that if interest in natural history is to be awakened in Central

America, competently written books, printed in Spanish, must be made available to students there. The Instituto Tropical de Investigaciones Científicas de la Universidad de El Salvador is to be congratulated for its projected series of scientific works in Spanish, of which this is the first, and the authors are to be commended for a job well done.—JOHN DAVIS.

AVES, ZOOLOGICAL RECORD, 91 (for 1954), Sect. 17. By W. P. C. Tenison. Zoological Society of London. 101 pp. Paper. 7s 6d.

LT. COL. W. P. C. Tenison has again performed an important service to ornithology by preparing the *Aves* section for the *Zoological Record*. The 1954 tabulation, received in the Wilson Ornithological Library in November, 1955, lists 1,972 titles of bird papers from all parts of the world. The usual cross-index provides an extensive key to the subject matter by "Subject" (67 headings), "Distribution—Geographical and Geological" (58 headings), and "Systematic" (110 family headings). Although by no means a complete tabulation of the ornithological output of 1954, this summary is easily our best single bibliographic source. Whether or not one has need to look up any reference whatever, a mere glancing through the Aves volume will give the reader such a cross-section of modern ornithology as can be secured in no other way.

Bird students may purchase copies of this valuable 101-page booklet from the Zoological Society of London, Regent's Park, London, N.W.1, England, for a dollar and ten cents, postpaid (7 shillings 6 pence, which may be conveniently paid by foreign money-order obtainable at U.S. Post Offices).—JOSSELYN VAN TYNE.

NEW LIFE MEMBER

Lukas Hoffmann, a native of Switzerland, earned his doctorate at the University of Basle, Switzerland. He now lives in the Camargue in southern France and spends much of his time in studies of migration and ecology of birds. Dr. Hoffmann bands about 5,000 birds each year. This picture shows him on his way to band Flamingoes. He has banded about 2,000 downy young of that species and has received some 60 returns from southern Europe and Africa.

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Editor of The Wilson Bulletin

KEITH L. DIXON
Department of Wildlife Management
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College Station, Texas

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